THE PATTERN OF ODONTOGENIC TUMORS IN A SINGLE GOVERNMENT TEACHING HOSPITAL IN THE STATE OF TAMIL NADU: A RETROSPECTIVE STUDY FROM THE FILES OF HISTOPATHOLOGY REGISTER.

Dissertation submitted to

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

towards the partial fulfillment for the degree of

MASTER OF DENTAL SURGERY

BRANCH – IV

ORAL PATHOLOGY & MICROBIOLOGY

MARCH 2009

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled **"The Pattern of Odontogenic Tumors in a Single Government Teaching Hospital in the State of Tamil Nadu: A retrospective study from the files of histopathology register"** is a bonafide and original research work done under the guidance of **Dr. I. Ponniah, MDS.,** Associate Professor, Department of Oral Pathology and Microbiology, Tamil Nadu Government Dental College and Hospital, Chennai - 600 003. I also declare that this work was done after careful and thorough analysis not amounting to any sort of plagiarisms or ethical deviations based on the retrospective records (1970 – 2008) of the Department of Oral Pathology and Microbiology.

Signature of the candidate

BHAWNA GUPTA

Chennai – 600 003
Tamil Nadu
India

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled **"The Pattern of Odontogenic Tumors in a Single Government Teaching Hospital in the State of Tamil Nadu: A retrospective study from the files of histopathology register"** is a bonafide research work done by **Dr. BHAWNA GUPTA** towards the partial fulfillment of the requirement for the degree of **MASTER OF DENTAL SURGERY** in the speciality of **ORAL PATHOLOGY AND MICROBIOLOGY (Branch IV),** under my constant supervision and critical evaluation.

Signature of the Guide

Chennai – 600 003

Tamil Nadu

India

Dr. I. Ponniah, MDS.

Associate Professor

Department of Oral Pathology and Microbiology

ENDORSEMENT BY THE PRINCIPAL / HEAD OF THE INSTITUTION

This is to certify that the dissertation entitled **"The Pattern of Odontogenic Tumors in a Single Government Teaching Hospital in the State of Tamil Nadu: A retrospective study from the files of histopathology register"** is a bonafide research work done by **Dr. BHAWNA GUPTA** under the guidance of **Dr. I. Ponniah, MDS.,** Associate Professor, Department of Oral Pathology and Microbiology, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003.

Signature of the Principal

Chennai – 600 003
Tamil Nadu
India

Prof. Dr. K.S.G.A.Nasser, MDS.
Principal
Tamil Nadu Government Dental
College and Hospital.

DECLARATION

I **Dr. Bhawna Gupta**, do hereby declare that the dissertation titled **"The Pattern of Odontogenic Tumors in a Single Government Teaching Hospital in the State of Tamil Nadu: A retrospective study from the files of histopathology register"** was done based on the archival samples and records (Department of Oral Pathology, Tamil Nadu Government Dental College & Hospital, Chennai 600 003) in partial fulfillment of the requirements for the degree of **Master of Dental Surgery** in the speciality of **Oral Pathology & Microbiology (Branch IV)** during the course period 2006-2009 under the conceptualization and guidance of my dissertation guide**, Dr. I. Ponniah, MDS.**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

Signature of the PG student

Signature of the HOD

Signature of the Head of the Institution

DEDICATED TO GOD & MY FAMILY

ACKNOWLEDGEMENT

I would like to thank **Dr. K.S.G.A. Nasser**, MDS, Principal, Tamil Nadu Government Dental College and Hospital, for not only granting me permission to undertake this study but also for providing the state of the art microtome without which it would have been difficult for me to complete my dissertation on time.

I owe my thanks to my batchmates, **Dr. N.V.Vani** and **Dr. V. Ilayaraja**, for their help and encouragement at various stages of my post-graduate course. I also thank my junior postgraduate students for their help and support.

My sincere thanks to **Mrs. Meenakshi** and **Mrs. Hilda Margaret**, BSc, the lab technicians at the Tamil Nadu Government Dental College and Hospital, and **Mr. Surendran,** the lab technician at the Madras Veterinary College, Chennai for their laboratory assistance during the course of this study. I would also like to thank **Mr. Ravanan** for the statistical analysis of the data for this study.

I express my sincere thanks to **Dr. Shaheen Ahmed** Formerly Professor and Head, and **Dr. M.R.C.Rajeswari**, MDS, Formerly Assistant Professor, for opening up the doors to learn the (he)art of Oral Histology.

I also express my sincere gratitude for the kind encouragement showered on me all through my postgraduation course by **Dr. R. Bharathi**, MDS, Assistant Professor and **Dr. S. Gnanadeepam**, MDS and **Dr. Rajakumar**, MDS.

I would like to thank my teacher, **Dr. I Ponniah**, MDS, Associate Professor, Department of Oral Pathology and Microbiology, Tamil Nadu Government Dental College and Hospital, Chennai for his guidance in the conceptualization, design and for critical appraisal of the document. His constant academic criticism though at the beginning would deter the lesser privileged, once adapted would eventuate in grasping the critical aspect of scientific learning. Hence, I consider my self fortunate to

have him as my academic teacher.

I would fail in my duty if I fail to recognize the teaching faculty who had served in the department in the order as found below; **Prof. Vishwanathan R, Prof. Saraswathi TR, Dr. Shantha Bharathan, Prof. Indirani VL, Prof. Chandrabai R, Prof. Shaheen Ahmed, Dr. Ponniah I, Dr. Rajeswari MRC, Dr. Bharathi R, Dr. Gnanadeepam** and technical staffs (**Mr. Balaraman, Mrs. Meenakshi, Mrs. Hilda Margaret**), and innumerable former and present postgraduate students of the Department of Oral & Maxillofacial Pathology, Tamil Nadu Government Dental College & Hospital, Chennai, for their invaluable endeavor towards contribution to the diagnosis and for preservation of vital source of information and materials to accomplish our task more easier.

ABSTRACT

Objective:

This institutional study was designed to determine the relative frequency of odontogenic tumors and to provide the information with reference to age, sex, anatomic location, and also to compare the data with the previous reports from other studies.

Material and methods:

A total of 489 cases of odontogenic tumors registered over a period of 38 years (February 1970 - March 2008) in the Department of Oral and Maxillofacial Pathology of Tamil Nadu Government Dental College and Hospital, Chennai, India were retrieved from the files of histopathology registers and were retrospectively analyzed.

Results:

Odontogenic tumors in the present study constituted 4.13% of all the 11843 registered biopsies. The mandible was the most commonly affected anatomic location with 362 cases (74.02%). Ameloblastoma with a predilection for posterior mandible was the most frequent odontogenic tumor (67.68%), followed by adenomatoid odontogenic tumor (9%), odontoma (7.77%) and calcifying odontogenic cyst (5.52%). The patients were affected over a wide age range of 5-75 years with a mean age of 32.64 years and peak occurrence in 2nd and 3rd decades of life. Among the 489 cases only 15 cases (3.07%) were malignant.

Conclusion:

The incidence of 4.13% of odontogenic tumors observed in this study is the largest series from this part of the world. Ameloblastoma formed the single most common tumor of all odontogenic tumors. This study observed both regional and geographic variations in the frequency and distribution of odontogenic tumors.

Key Words:

Odontogenic tumors; Incidence; Tamil Nadu; Government; Chennai; India; Ameloblastoma; Adenomatoid odontogenic tumor.

CONTENTS

ABBREVIATIONS

AF:	Ameloblastic fibroma
AFO:	Ameloblastic fibro-odontoma
AME:	Ameloblastoma
AOT:	Adenomatoid odontogenic tumor
CCOT:	Clear cell odontogenic tumor
CEOT:	Calcifying epithelial odontogenic tumor
COC:	Calcifying odontogenic cyst
MYX:	Myxoma
OF:	Odontogenic fibroma
PIOC:	Primary intraosseous odontogenic carcinoma
SOT:	Squamous odontogenic tumor
SPSS:	Statistical package for the social sciences version
Sq km:	Square kilometer
UCA:	Unicystic Ameloblastoma
WHO:	World Health Organisation

INTRODUCTION

Odontogenic tumors are the lesions derived from epithelial, ectomesenchymal, or both elements of odontogenic apparatus or its remnants. The spectrum of biological behaviour of these tumors ranges from non neoplastic to benign but locally destructive, to lesions with metastatic capabilities.[1] These are unique and specific lesions to the jaws, but are relatively uncommon. A review of literature regarding the frequency of occurrence of odontogenic lesions in various populations revealed that they account for 1-32% of all the lesions occurring in the oral cavity [2, 3, 4].

Odontogenic tumors constitute a heterogenous group of lesions with diverse histopathological features. They possess two major characteristics in that they arise from the tissue with the potential for differentiation into tooth or periodontal structures, and are therefore, found exclusively in the mandible and maxilla, and on rare occasions, gingiva. Another variable but distinct feature includes the display of various inductive interactions of primitive epithelium and ectomesenchyme that normally occur among the two embryonic components in the developing tooth germ and result in formation of tooth related extracellular substances, some of which may calcify and be visible on radiographs[15]. The specific histological structures reflect various stages of odontogenesis.

Odontogenic Tumors are usually slow growing and asymptomatic lesions. Certain Odontogenic tumors have a predilection for particular age groups, gender specificity, and anatomic locations. The most common sites of these tumors are the mandibular molar region and maxillary cuspid region.

A number of studies from different countries have been conducted and published. These studies have documented the demographic characteristics in their respective population with respect to age, gender and site of involvement. These reports also indicate the differences in the relative frequency of individual odontogenic tumors, suggesting geographic variations in different parts of the world.

Although the global incidence of odontogenic tumors can be ascertained based on the documented literature, the incidence and regional variations pertaining to the occurrence of

odontogenic tumors among Indian population is difficult to ascertain. The problem stems from two factors: firstly, there is not much available published data from this part of the world except for a single report in recent years from the state of Maharashtra, India, which cannot be representative of the entire population of India. Since diverse group of people (defined by race and religion) are concentrated in different parts of the country (represented by states and different linguistic and cultural habits) assessment of the relative incidence in different population groups would be of paramount importance to understand the regional variations in the incidence of odontogenic tumors, if any. And secondly, to overcome the paucity of available information efforts were made to collect information from individual dental teaching hospitals in India, (annexure I) but the information was very much limited for any meaningful comparison.

In view of this limited published information, as mentioned above, it was deemed prudent to gather a baseline data to determine the relative frequency and distribution of various types of odontogenic tumors from the biopsy records of the Department of Oral Pathology, Tamil Nadu Government Dental College and Hospital. Since it is the only tertiary referral centre for dental health in the ministry of health and family welfare, Government of Tamil Nadu, information from the biopsy register over a period of 38 years would provide reliable data for future research as it caters to the dental needs of the population of Chennai which has an estimated population of 7.5 million in 2007 spreading over an area of 174 sq.km[5]. Although there are approximately ten dental teaching hospitals in Chennai, this institution is the oldest of all with a high patient inflow from Chennai as well as from other parts of Tamil Nadu and the neighboring state of Andhra Pradesh.

The purpose of this study, is therefore, to examine the epidemiology of odontogenic tumors and in particular, to provide the data with reference to age, sex, site and histologic subtypes of these lesions reported in this part of the country, and also to provide the data for comparison with other epidemiologic findings in different geographic locations in order to detect subtle population differences.

AIMS AND OBJECTIVES

This retrospective study aims –

1. To determine the relative frequency of odontogenic tumor types.

2. To provide the data with reference to age, sex, anatomic location and histologic subtypes of these lesions reported in the Department of Oral Pathology and Microbiology, Tamil Nadu Government Dental College and Hospital, Chennai, South India from 1970 to 2008.

3. To compare the data both within and outside India, and to provide data for future epidemiological research.

REVIEW OF LITERATURE

Section I: Frequency

Gunhan et al in 1990[6] did a multicentric, collaborative retrospective study of 409 cases of odontogenic tumors in Turkey. In their study, odontogenic tumors constituted 1.3% of all oral specimens. There were 403 benign and 6 malignant odontogenic tumors in that series. Of the benign tumors, ameloblastomas were the most frequent lesions constituting 149cases (36.5%), followed by 74 cases (18%) of odontomas, 11 cases of AOT, and 6 cases of CEOT. Sixty two cases of cementoblastoma, 51 cases of odontogenic myxoma, and 18 cases each of ameloblastic fibroma and odontogenic fibroma were also seen. Of the malignant neoplasms, 5 cases of malignant ameloblastoma and one of ameloblastic fibrosarcoma were found.

Odukoya in 1995[2] analyzed 289 cases of odontogenic tumors in a Nigerian population over a period of 21 years (1971-1991) which constituted 19% of tumors and tumor-like lesions of the oral cavity and the jaws. Benign odontogenic tumors were seen more frequently (274 cases; 94.8%) than malignant odontogenic tumors (15 cases; 5.2%). He found ameloblastoma to be the most prevalent odontogenic tumor accounting for 58.5 % (169 cases). Also noted were 18 cases (6.23%) of AOT, 3 cases of SOT (1.04%) and only 1 CEOT (0.35%). The 2nd category showed 13 cases of ameloblastic fibroma constituting 4.5%, 12 cases of odontoma (4.15%), and 7 cases of COC (2.42%). Among the tumors of ectomesenchymal origin myxoma was most prevalent, accounting 34 cases (11.76%), odontogenic fibroma 13 cases (4.50%), and cementoblastoma 2 cases (0.69%). Of the malignant tumors, odontogenic carcinoma was the most prevalent tumor affecting 14 patients (4.84%), whereas only 1 case of odontogenic sarcoma was found.

Chidzonga et al in 1996 [7] did a study entitled “Odontogenic Tumors: Analysis of 148 cases in Zimbabwe”. In their retrospective study of a total of 1723 biopsies over a 10 year period, 8.6% was the

frequency of occurrence of odontogenic tumors. Of the total cases, ameloblastoma was the commonest odontogenic tumor accounting for 79.1%. The only malignant odontogenic tumor noted was ameloblastic fibro-sarcoma.

Arotiba et al in 1997 [8] in a 15 year (1980-1994) retrospective review of oral and jaw tumors from Ibadan, Nigeria, found the prevalence of odontogenic tumors to be 30%, as only 128 cases out of 423 were confirmed histologically to be odontogenic tumors. Ameloblastoma was the most common histological type (n=76, 59%), followed by odontogenic myxoma (n=21, 16%), AOT (n=16, 13%). COC, CEOT and central odontogenic fibroma constituted for 2% each, whereas there was no odontome and cementoblastoma in their study. Of the malignant lesions, only 2 cases of PIOC and 1 case of ameloblastic fibrosarcoma was found.

Taylor et al in 1997 [9] conducted a collaborative retrospective study of 349 cases of odontogenic tumors in Mexico. The frequency of odontogenic tumors was 2.5%. 345 were benign tumors constituting 98.8% and 4 were malignant (1.1%). The most frequently occurring tumors were odontoma (34.6%), ameloblastoma (23.7%), and myxoma (17.7%), followed by AOT (7.1%), and COC (6.8%). Other less common types of lesions found were ameloblastic fibroma (1.4%), central odontogenic fibroma (1.4%), cementoblastoma (0.8%), and CEOT (0.8%). In the malignant category, 3 were primary intraosseous carcinomas and 1 was malignant ameloblastoma.

Yong Lu et al in 1998[10] did a study entitled "Odontogenic tumors: A demographic study of 759 cases in a Chinese population" over a period of 43 years (1952-1994). Among these cases, 93.9% of the tumors were benign (n=713) and 6.1% were malignant (n=46). Ameloblastoma predominated with 58.6%, followed by odontogenic myxoma (8.4%), and AOT (8.3%), while odontomas accounted for only 6.7%. Malignant ameloblastoma (3.2%) was the most frequent malignant odontogenic tumor, followed by PIOC (1.4%).

Santos et al in 2001[11] did analysis of 127 cases of odontogenic tumors reported over a period of 30 years (1970-1999). All cases were benign lesions whereas they found no malignant tumor. Sixty

four tumors were diagnosed as odontomas, which corresponded to the most frequent tumor, accounting for 50.4% of all cases followed by 39 cases of ameloblastoma accounting for 30.7%. Eleven cases of AOT (8.67%), 6 cases of odontogenic myxoma (4.72%), and 3 cases of cementoblastoma (2.37%) were also found.

Ochsenius et al in 2002[12] conducted a study of 362 cases of odontogenic tumors registered over a period of 25 years (1975-2000) in Chile. The frequency of odontogenic tumors as a percentage of all pathological specimens was 1.29%. Of the 362 odontogenic tumors, 360 were benign (99.4%) and only 2 were malignant (0.6%). The most frequent histological type was odontomas, constituting 162 cases (44.7%), followed by 74 cases of ameloblastoma (20.4%), and 32 cases of myxoma (8.8%). Rest comprised 26 cases (7.2%) of COC, 24 cases of AOT (6.6%), and 20 cases of odontogenic fibroma (5.5%). SOT, CEOT, CCOT, ameloblastic fibroma and ameloblastic fibrodentinoma accounted for 0.6% each (2 cases each). Of the malignant, one case of odontogenic carcinosarcoma and one of ameloblastic fibroodontosarcoma was found.

Simon et al in 2002[13] published a retrospective study of Odontogenic tumors and tumor-like lesions in Tanzania recorded during a period of 15 years (1982-1997). In their study, odontogenic tumors comprised about 12.2% of all oral tumors and tumor-like conditions. Ameloblastoma was the most commonly seen odontogenic tumor (73.7%), followed by odontogenic myxoma (10.3%).

Adebiyi et al in 2004[14] conducted analysis of 197 ectodermal odontogenic tumors observed during a period of 21 years (1973-1993) in a Nigerian population. Of the 197 cases, 182 (92.3%) were benign while 15 (7.6%) were malignant. Central ameloblastoma, which accounted for 88.3% (n=174) in the series, was the most common benign neoplasm. Ameloblastic carcinoma was the most prevalent malignant tumor (n=11, 5.6%).

Tamme et al in 2004[15] conducted a collaborative retrospective study of 75 cases of odontogenic tumors, covering more than 25 years from Estonia. The frequency of odontogenic tumors in their study was the lowest ever reported; as out of total 10,141 biopsies, only 75 cases of

odontogenic tumors were identified, accounting for 0.74% only. Of the 75 cases, 74 (98.6%) were benign and 1(1.3%) was malignant. The most frequent benign tumor was odontoma (34.3%), followed by ameloblastomas (25.3%), ameloblastic fibroma (16%), odontogenic myxoma (12%) and benign cementoblastoma (8%). The other less common types were CEOT and AOT, accounting for 1.3% each. The only malignant tumor was PIOC.

Adebayo et al in 2005[4] reviewed 318 odontogenic tumors registered during a period of 20 years (1979-1998) in Kaduna, Nigeria. The frequency of odontogenic tumors as a percentage of all tumor and tumor like lesions of the oral and paraoral structures (990 cases) was 32%. Of the 318 tumors, 314 (99%) were benign lesions and 4 (1%) were malignant. Ameloblastoma made up 73% (233 cases) of the tumors, followed by odontogenic myxoma 38 (12%), ameloblastic fibroma 9 (3%), and the AOT (2%). Among the malignant types, there were 3 odontogenic carcinomas and 1 odontogenic sarcoma.

Simon et al in 2005[16] conducted a 4-year (1999-2003) prospective study on epidemiology and clinicopathological presentation of odontogenic tumors in Tanzanian population. A total of 116 patients were seen during this period. The authors have concluded that frequency of ameloblastoma (80.1%) far outnumbered the frequency of other odontogenic tumors.

Ladeinde et al in 2005[3] did a study entitled “Odontogenic tumors: A of 319 cases in a Nigerian teaching hospital”. They found that odontogenic tumors constituted 9.6% (319cases) of all the 3337 biopsies of oral and jaw lesions seen within a period of 24 years (1980-2003). 308 tumors (96.6%) were located intraosseously, and 11 (3.4%) were peripheral. Among the peripheral lesions there were 7 cases of peripheral odontogenic fibroma, 3 cases of peripheral myxoma and 1 of peripheral ameloblastoma. The same ratio was observed between benign and malignant lesions i.e. 308 (96.6%) were benign and 11 (3.4%) were malignant lesions. Ameloblastoma was the most frequent odontogenic tumor (63%), followed by AOT (7.5%), myxoma (6.5%), COC (5.3%), and odontogenic fibroma (5.3%). More cases of malignant odontogenic tumors were seen than cases of CEOT and odontomas.

Ameloblastic carcinoma was the most common of malignant odontogenic tumors.

Fernandes et al in 2005[17] did a study of 340 cases of odontogenic tumors reported over a period of 51 years (1954-2004) in a Brazilian population. The frequency of odontogenic tumors comprised of 1.78% of all pathologic specimens during a period of 50 years. There were 338 (99.4%) benign lesions and only 2 (0.6%) malignant lesions. The most frequent benign tumor was Ameloblastoma 154 cases (45.2%), followed by odontomas 85 cases (24.91%), and myxoma 31 cases (9.1%). 13 cases of AOT and 12 cases of COC follow next. The malignant lesions included one ameloblastic carcinoma and a clear cell odontogenic carcinoma (CCOT).

Buchner et al in 2006[18] did a study titled "Relative Frequency of Central Odontogenic Tumors: A Study of 1,088 Cases from Northern California and Comparison to Studies from Other Parts of the World". Odontogenic tumors comprised 1088 cases out of 91,178 biopsies accessed during the 20 year period, thus accounting for a general frequency of 1.2%. Individually, of all tumors, 75.9% were odontomas. The prevalence of the remaining tumors appears to be a rare occurrence. The second most common was ameloblastoma (11.7%), followed by odontogenic myxoma (2.2%).

Jing et al in 2006[19] did a study titled "Odontogenic Tumors: a retrospective study of 1642 cases in a Chinese population". These cases were registered over a 52-year period (1952-2004). Of these tumors 1592 (97%) were benign and 50 (3%) were malignant. Ameloblastoma (661 cases, 40.3%) was the most frequent type, followed by keratocystic odontogenic tumor (588 cases, 35.8%), odontoma (78 cases, 4.7%), and odontogenic myxoma (76 cases, 4.6%). Sixty eight cases of AOT, 45 cases of COC, 33 cementoblastoma, 19 ameloblastic fibroma and 10 cases of CEOT were found. Among the malignant lesions, ameloblastic carcinoma was most prevalent with 27 cases, followed by 14 cases of PIOC.

Olgac et al in 2006[20] studied 527 cases of Odontogenic Tumors in Istanbul. Out of total 62,565 cases registered in their department from 1971 to 2003 (32 years period), 527 cases of odontogenic tumors constituted even less than 1% (0.83%). There were 521 benign tumors and 6 malignant. The

common lesions were Ameloblastoma (n=133, 25%), followed by odontoma (n=109, 21%), and odontogenic myxoma (n=83, 16%).

Okada et al in 2007[21] conducted a study titled "Odontogenic Tumors in Sri Lanka: Analysis of 226 Cases". They analyzed 226 cases reported from 1996 to 2002 (7 years duration). Of these 226 cases, 220 (97.3%) were benign and only 6 (2.7%) were malignant. The most frequent benign tumor was ameloblastoma (157 cases; 69.8%), followed by adenomatoid odontogenic tumor (21 cases; 9.3%), odontogenic myxoma (11 cases; 4.9%), and odontomas and calcifying odontogenic cysts (10 cases each; 4.4%). Clear cell odontogenic carcinoma (3 cases; 1.3%) was the most frequent malignant tumor; the other malignancies included primary intraosseous carcinoma (2 cases; 0.9%) and ameloblastic fibrosarcoma (1 case; 0.4%).

Sriram et al in 2008[22] conducted a retrospective study of 250 cases of Odontogenic Tumors managed during a period of 36 years (1971-2006) in an Indian teaching hospital. Of the 250 tumors, 247 were benign and only 3 were malignant. Of the latter, all 3 were ameloblastic carcinomas. In the benign lesions, ameloblastoma predominated with 154 cases (61.6%), followed by 31 cases of AOT (12.4%), 15 cases (6%) each of odontoma and myxoma. The rest comprised 12 cases of odontogenic fibroma, 7 cases of COC (2.8%), and 6 cases of CEOT (2.4%).

Section II: Age

Gunhan et al in 1990[6] did a multicentric, collaborative retrospective study of 409 cases of odontogenic tumors in Turkey. The average age of the patients was 31 years for benign tumors and 24.6 years for the malignant ones, with an age range of 2 to 86 years. Ameloblastoma affected patients in the age range of 5-86 years with a mean age of 36.7 years. For AOT patients, age ranged from 15 – 50 years with a mean age of 20.2 years. Ameloblastic fibroma affected the youngest, a 2 year old patient, and ranged upto 42 years with a mean age of 31 years. Odontoma showed a wide age range of

9 to 60 years with a mean of 26.3 years.

Odukoya et al in 1995[2] conducted a retrospective study of 289 cases of odontogenic tumors in a Nigerian population. They analyzed that the age range varied from 2.5 to 82 years. The youngest, a 2 ½ year old patient, was a case of ameloblastic fibroma and the oldest, an 82 years old patient, in the series was a case of ameloblastoma. They found that the first group of benign tumors ranged in age from 10-82 years with a mean of 29 years. The second group showed an age range of 2.5-54 years with a mean of 18 years. The 3rd group ranged from 5-78 years of age with a mean of 20 years. The malignant tumors showed a mean age of 35 years. Analysis of 169 cases of ameloblastoma in their series showed that it occurred in the widest age range from 0-82 years with a mean age of 31 years.

Arotiba et al in 1997[8] in a 15 year retrospective review of oral and jaw tumors from Ibadan, Nigeria, observed that the odontogenic tumors were most common in the 2nd to 4th decade with a peak incidence in 3rd decade (n=36). In general, the patient's age ranged from 8-75 years, about 70% of the patients being between 11 and 40 years. For ameloblastoma, the patients age ranged from 8 to 72 years with a mean of 33 years and a median age of 30 years. AOT affected patients over a significantly wide age range of 9 to 75 years with a mean age of 22 years.

Yong Lu et al in 1998[10] did a study titled "Odontogenic tumors: A demographic study of 759 cases in a Chinese population". The mean age of this patient population was 29.3 years with a wide range of 3-77 years. 525 cases (69.2%) were found during the 2nd, 3rd, and 4th decade, with a peak in the 3rd decade (27.5%). Ameloblastic fibroma (mean age, 23.9 years), ameloblastic fibro-odontoma (mean age, 23.5 years), odontoameloblastoma (mean age, 15 years), adenomatoid odontogenic tumor (mean age, 22.6 years), compound odontoma (mean age, 17 years), odontogenic fibroma (mean age, 16.4 years), odontogenic myxoma (mean age, 19.6 years), and benign cementoblastoma (mean age, 20.7 years) were the odontogenic tumors most commonly seen in younger patients. The malignant odontogenic tumors had a predilection for patients more than 40 years of age.

Santos et al in 2001[11] analyzed 127 cases which showed age range from 4 to 82 years with

peak incidence in 2nd and 3rd decades of life and average of 26.6 years.

Ochsenius et al in 2002[12] reviewed 362 cases of odontogenic tumors in Chile. The age range for odontogenic tumors as a whole was from 1 to 82 years. The average patient age was 25.2 years for benign tumors. With regard to benign tumors, there was no significant difference in age distribution with a mean of 24.5 years for males and 25.8 years for females. Odontomas peaked in 2nd decade. Myxomas and COC also present a greater frequency in 2nd decade, but not as pronounced as in the case of the odontomas. Ameloblastomas showed a bimodal curve with one peak in the 3rd decade and another in 5th decade. Regarding AOT, 88% cases were distributed between age 12 and 25.

Simon et al in 2002[13] did a study of Odontogenic tumours and tumour-like lesions in Tanzania. In their study, the majority of odontogenic tumours (55.3%) were seen in patients below 30 years of age.

Adebiyi et al in 2004[14] conducted analysis of 197 ectodermal odontogenic tumors in a Nigerian population. The tumors occurred over an age range of 8-85 years, with a peak age incidence in the 3rd decade. Benign lesions were most common in the 3rd decade while the malignant ones presented more frequently in the 2nd and 4th decades. Central ameloblastoma, which was the most common benign neoplasm in this study showed an age range of 9-82 years with a mean age of occurrence (±SD) 31.0 ± 13.9. Similarly the mean age (±SD) was 30.1±20.7. Age range was 16-85 years for ameloblastic carcinoma, which was the most prevalent malignant tumor in this study. For SOT the mean age of occurrence was 36.6±10.0 (range 20-45) years.

Tamme et al in 2004[15] conducted a collaborative retrospective study of 75 cases of odontogenic tumors, covering more than 25 years from Estonia. Of the 75 cases, 51 cases (68%) were found during the 2nd, 3rd, and 4th and 6th decade of life.

Adebayo et al in 2005[4] conducted a review of 318 odontogenic tumors in Kaduna, Nigeria. The patients ranged in age from 1 to 78 years with the mean age of 29 years. Ameloblastoma, myxoma and ameloblastic fibroma peaked in 3rd decade, whereas AOT and odontoma peaked in 2nd decade. Cases of

CEOT were seen only in 6th decade between 50-55 years of age. Ameloblastoma showed the widest age range from 7 to 75 years with mean age of 29 years.

Simon et al in 2005[16] conducted a 4-year prospective study on epidemiology and clinicopathological presentation of odontogenic tumors in Tanzania. Most (71%) patients with odontogenic tumors were in the age group of 10 to 39 years with a mean of 32 years. Ameloblastoma occurred with a mean age of 35 years. The 9 cases of unicystic ameloblastoma occurred over a wide age range of 15 to 50 years with a mean of 27 years.

Ladeinde et al in 2005[3] did a study titled "Odontogenic tumors: A review of 319 cases in a Nigerian teaching hospital". The mean age of patients was 29.9±15.6 years in a wide age range of 4-85 years. No significant difference was found between the mean ages of the patients with benign odontogenic tumors and those with malignant odontogenic tumors (P=.058). Odontogenic tumors were most frequent in the 2nd to 5th decade, 88.1% of patients being between 11 and 50 years. The mean age (±SD) of patients with ameloblastoma was 31.7±15.3 years (range, 4-82 years) with a peak incidence in the 3rd decade. The mean age (±SD) of patients with AOT (16.6±5.7), ameloblastic fibroma (15.7±3.0), and odontoma (22.3±11.2) were significantly lower than those with ameloblastoma (P<.05).

Fernandes et al in 2005[17] did a study of 340 cases a Brazilian population. The mean age of their patient population was 25.5, with a wide range (1-82 years). About 250 cases were found in 2nd, 3rd and 4th decades, with a peak in the 2nd decade i.e.112 cases (32.9%), followed by 87 cases in 3rd decade, 51 in 4th decade, 29 in 5th decade, and 11 in 6th decade. The most prevalent odontogenic tumor in the 2nd decade of life was ameloblastoma (42%), followed by odontoma (28.3%), and myxoma (9.8%). Except in the 1st decade where the most prevalent lesion was odontoma, ameloblastoma was the most predominant in rest of the decades.

Buchner et al in 2006[18] did a study titled "Relative Frequency of Central Odontogenic Tumors: A Study of 1,088 Cases from Northern California and Comparison to Studies from Other Parts of the World". For odontomas, age at the time of treatment was known for 762 patients out of 826 cases. The

age ranged from 1 year to 90 years with a mean of 18.4 years and median 15 years. The highest frequency was in the 2nd decade (56.2%). Of these 127 cases of ameloblastoma, solid ameloblastoma accounted for 69 cases and 58 cases formed the unicystic type. In those solid ameloblastoma, the patient's age ranged from 14 to79 years (mean 48 years, median 48 years) with the maximum cases reported in 5th decade of life. And for unicystic ameloblastoma, the corresponding figure ranged from 10 to 71 years (mean 29.4 years, median 24 years) with the maximum number of cases found in the 2nd decade. For CEOT, patients ranged in age from 44 to 58 years (mean 51.6years, median 54 years).

For AOT, patients ranged in age from 4 to 47 years (mean 20.2 years, median 15 years). The highest frequency was in the 2nd decade, with 50% of the patients in this age group. 17 patients of ameloblastic fibroma ranged in age from 3 to 26 years (mean 9.2 years, median 8 years). The highest frequency was in the 1st decade, with 65% of the patients in this age group. There were 25 cases of odontogenic myxoma. The patients ranged in age from 13 to 69 years (mean 36.1 years, median 37 years). The highest frequency was in the 4th and 5th decade, with 57% of the patients in these age groups. Benign cementoblastoma patients ranged in age from 9 to 33 years (mean 19.8 years, median 20 years).

Jing et al in 2006[19] conducted a study titled "Odontogenic Tumors: a retrospective study of 1642 cases in a Chinese population". The age of the patients ranged from 3 to 84 years with a mean age of 32.1 years. 67.6% of cases were distributed between age 10 and 39 with a peak incidence in the 3rd decade (27.6%), except AOT and odontoma which showed a significant predilection for 2nd decade. Malignant tumors occurred more frequently in the 5th and 6th decade of life.

Olgac et al in 2006[20] studied 527 cases of Odontogenic Tumors in Istanbul. The ages of the affected patients varied widely (range 3-85 years). The tumors occurred mainly in young people between the ages of 10 to 39 (n=352, 67%). The maximum number of lesions affected patients in 2nd and 3rd decade (n=236) except COC which showed predominance after 60 years of age.

Okada et al in 2007[21] conducted a study titled "Odontogenic Tumors in Sri Lanka: Analysis of

226 Cases". For all odontogenic tumors, the age of occurrence ranged from 1 to 84 years (average, 31.4 years). Most cases (175; 77.4%) occurred in the second to fifth decades of life, with a peak in the second decade (54 cases; 23.9%). The average age of occurrence was 33.2 years for ameloblastoma, 18.2 years for adenomatoid odontogenic tumor, 33.9 years for myxoma, 23.9years for odontoma, and 34.9 years for calcifying odontogenic cyst. Peak incidence occurred in the second decade for all of these tumors except ameloblastoma, which had the highest prevalence in the fourth decade.

Sriram et al in 2008[22] retrospectively analyzed 250 cases of odontogenic tumors registered over a period of 36 years in an Indian teaching hospital in Mumbai, India. The mean age of this population was 29.81 years, with a wide range of 2.5 to 75 years. Age distribution of all of the odontogenic tumors showed a peak occurrence in the 3rd decade, with 83.6% of the cases occurring between the 2nd and 5th decade. Ameloblastoma, the most common tumor in this study, showed a peak occurrence in the 3rd decade, with 74% of the cases in 3rd decade. AOT and myxoma predominantly occurred in 2nd decade. A comparison of mean age of presentation of the common odontogenic tumors in their study showed that AOT and myxoma occurred at significantly lower-aged individuals compared with ameloblastomas.

Section III: Gender

Gunhan et al in 1990[6] did a multicentric, collaborative retrospective study of 409 cases of odontogenic tumors in Turkey. Of the 409 cases, 203 were males and 196 were female patients. In contrast to general male predominance AOT, cementoblastoma, and odontogenic myxoma affected female patients more than male patients.

Odukoya et al in 1995[2] in a retrospective study of 289 cases of odontogenic tumors in a Nigerian population, found a general prediction for males constituting 56.1% whereas 43.9% were female patients. Benign odontogenic tumors categorized as of "odontogenic epithelium without odontogenic ectomesenchyme" were more common in males (65.3%) than females (37.7%), whereas

those categorized as of "odontogenic epithelium with odontogenic ectomesenchyme, with or without dental hard tissue formation" occurred more frequently in females (63.5%) than in males (36.5%). Adenomatoid odontogenic tumor, which occurred more than twice as commonly in females (72.2%) as in males (27.8%) was the most frequently observed odontogenic tumor in this category. Further observation showed that malignant odontogenic tumors were slightly more common in males (53.3%) than females (46.7%).

Arotiba et al in 1997[8] in a 15 year retrospective review of oral and jaw tumors from Ibadan, Nigeria, reported almost equal sex prevalence with an overall male: female ratio of 1.1:1. Of the 76 cases of ameloblastoma, 45 were male and 31female patients, the male: female ratio being 3:2. Adenomatoid odontogenic tumor affected male and female patients with an equal frequency. Fibromyxoma showed a female predominance with 13 female and 8 male patients (M: F ratio 2:3).

Taylor et al in 1997[9] conducted a collaborative retrospective study of 349 cases of odontogenic tumors in Mexico. In their study they reported an overall female predominance with 193 female patients (55.3%) and 154 male patients (44.1%). Ameloblastoma, AOT, myxoma, and odontoma all showed a female predominance, though the only malignant tumor, the odontogenic carcinoma occurred only in males.

Yong Lu et al in 1998[10] did a study titled "Odontogenic tumors: A demographic study of 759 cases in a Chinese population". In their study they found that 428 cases were male and 329 were female patients, gender description was not specified for 2 cases. Notably, malignant tumors were significantly more common in male than in female patients (M: F ratio, 2.1:1), whereas benign tumors showed almost equal gender prediection (M: F ratio 1.1:1).

Santos et al in 2001[11] reported in their analysis of 127 cases that more than 60% of all tumors occurred in females and 36.22%, in males. Out of the 39 cases of ameloblastoma, 22 occurred in females and 17 in male patients. Like wise AOT, benign cementoblastoma, ameloblastic fibroma and odontomas also showed female predominance.

Ochsenius et al in 2002[12] in their study on 362 cases of odontogenic tumors reported an overall female predominance with 194 females (53.59%) and 168 male patients (46.40%). Ameloblastoma, odontoma and myxoma showed a female predominance whereas AOT and benign cementoblastoma affected more of male patients.

Adebiyi et al in 2004[14] conducted analysis of 197 ectodermal odontogenic tumors in a Nigerian population. The tumors were found to be more common in males (114 cases, 57.9%) than females (83 cases, 42.1%). Exception was SOT, which occurred exclusively in females (63.6%). Ameloblastoma showed a male to female ratio of 1.5:1.

Tamme et al in 2004[15] conducted a collaborative retrospective study of 75 cases of odontogenic tumors, covering more than 25 years from Estonia. The 75 lesions were distributed in 28 males and in 47 females, thus showing a clear female predominance, and the overall male to female ratio of 1:1.7.

Simon et al in 2005[16] conducted a 4-year prospective study on epidemiology and clinicopathological presentation of 116 cases of odontogenic tumors in Tanzania. In their study, they reported an overall female predominance with 58 female and 53 male patients. Gender was not specified for 5 cases. Ameloblastoma had an equal distribution between males and females.

Adebayo et al in 2005[4] conducted a review of 318 odontogenic tumors in Kaduna, Nigeria. There was a general male predominance with 183 cases (57.55%) and 135 female patients (42.45%). The male: female ratio being 1.35:1. Individually all lesions showed a male predominance except odontogenic myxoma, which notably showed female predominance with M: F ratio being 1:2.8.

Ladeinde et al in 2005[3] did a study titled “Odontogenic tumors: A review of 319 cases in a Nigerian teaching hospital”. In their study, there was an overall male: female ratio of 1:1 with 162 male and 157 female patients. Malignant odontogenic tumors occurred more in males than females (7:4). Among the benign lesions, ameloblastoma, CEOT, COC, odontogenic fibroma, and cementoblastoma were more prevalent in males whereas ameloblastic fibroma, AOT and myxoma were seen more

commonly in female patients.

Fernandes et al in 2005[17] did a study of 340 cases a Brazilian population. Of the 340 odontogenic tumors, the gender distribution was 187 females (55%), 152 males (45%) and one not related. This states a general female predominance except odontomas, which affected males more often than females. Benign tumors presented a male: female ratio of 1:1.2 and all malignant tumors were found in females.

Buchner et al in 2006[18] did a study titled "Relative Frequency of Central Odontogenic Tumors: A Study of 1,088 Cases from Northern California and Comparison to Studies from Other Parts of the World". For odontomas, information regarding gender was known for 762 patients out of 826 cases with almost equal distribution between males (51.2%) and females (48.8%).

Males were more frequently affected by solid type ameloblastoma than females (59% and 41% respectively), whereas unicystic ameloblastoma affected females more frequently than males (59% and 41% respectively). In cases of AOT there was almost equal distribution between genders involving 10 females (52.6%) and 9 males (47.4%). Ameloblastic fibroma affected 11 males (65%) and 6 females (35%). Odontogenic myxoma showed a significant female predilection (74%). Males were affected more than females by benign cementoblastoma involving 7 males and 3 females.

Jing et al in 2006[19] did a study titled "Odontogenic Tumors: a retrospective study of 1642 cases in a Chinese population". The gender distribution was 959 male and 680 female patients with 3 cases of unspecified gender. The male-female ratio was 1.4:1 for benign lesions and 1.9:1 for malignant tumors. Their study showed a general male predominance except for AOT, odontoma, odontogenic myxoma, and cementoblastoma which affected female patients more than males.

Olgac et al in 2006[20] studied 527 cases of Odontogenic Tumors in Istanbul. Overall there were more female patients (n=278, 53%) in their study than male patients (n=249, 47%). Ameloblastoma, AOT, benign cementoblastoma, odontogenic myxoma affected female patients more often than males. In contrast, odontomas affected male patients more than females.

Okada et al in 2007[21] conducted a study titled "Odontogenic Tumors in Sri Lanka: Analysis of 226 Cases". The patient group showed a general female predominance which comprised 107 males (47.3%) and 119 females (52.7%). Of the 220 cases of benign odontogenic tumors, 103 (46.8%) were diagnosed in males and 117 (53.2%) in females. Of the 6 cases of malignant odontogenic tumors, 4 (66.7%) were diagnosed in males and 2 (33.3%) in females. There was no gender predilection for ameloblastoma (1:1). The male-to-female ratio in calcifying epithelial odontogenic tumor (CEOT) was 2:1. An apparent female predilection was seen for adenomatoid odontogenic tumor (1:2.5), compound odontoma (1:3), and myxoma (1:1.8).

Sriram et al in 2008[22] retrospectively analyzed 250 cases of odontogenic tumors registered over a period of 36 years in an Indian teaching hospital in Maharashtra, India. Among the 247 benign tumors, 136 were found in males and 114 in females with an overall male: female ratio of 1.2:1. Gender analysis of individual benign tumor revealed a female predilection for most of the tumors except ameloblastoma, COC, and odontogenic fibroma. All the three cases of ameloblastic carcinoma preferably affected males, sparing the other sex.

Section IV: Anatomical location

Gunhan et al in 1990[6] did a multicentric, collaborative retrospective study of 409 cases of odontogenic tumors in Turkey. Tumors predominated in the lateral and posterior regions of the mandible and maxilla (76%). Of the 149 cases of ameloblastoma, 71% involved the mandibular posterior area which was the predominant site for all odontogenic tumors. Complex and compound odontomas predominate in different regions, the former involving molar and the altter involving anterior regions more frequently. Only 24% of all tumors were located anteriorly, more frequently in female patients (27%) than in males (20%).

Odukoya et al in 1995[2] in their study titled "Odontogenic Tumors: analysis of 289 Nigerian cases" found that odontogenic tumors had a predilection for the mandible, although adenomatoid

odontogenic tumor, calcifying odontogenic cyst and odontogenic fibroma showed a predilection for the maxilla. Ameloblastoma had a site predilection for the posterior mandible (74%) with occurrence in the anterior mandible being 26%, and only 3 cases in the maxilla. Squamous odontogenic tumor, calcifying epithelial odontogenic tumor, cementoblastoma and malignant tumors showed 100% predilection for mandible with no case in the maxilla.

Arotiba et al in 1997[8] in a 15 year retrospective review of 128 odontogenic tumors from Ibadan, Nigeria, reported an equal distribution between the mandible and the maxilla. 69 (91%) of the ameloblastoma patients had mandibular lesions and 7 (9%) had maxillary lesions. The most common site involved was the posterior mandible (horizontal ramus, *n*=44, 80%). The adenomatoid odontogenic tumor affected the maxilla in 11 patients (69%) with 8 tumors in the anterior maxilla, and the mandible in 5 patients (31%). The fibromyxoma affected the mandible (n=10) and the maxilla (n=11) with almost equal frequency.

Taylor et al in 1997[9] conducted a collaborative retrospective study of 349 cases of odontogenic tumors in Mexico. There were 169 lesions in the mandible (50.7%) and 164 in the maxilla (49.2%). The most frequently affected areas were the posterior aspect of the mandible and the anterior region of the maxilla, with 59.1% and 53% of all tumors found in each location, respectively.

Yong Lu et al in 1998 [10] did a study titled "Odontogenic tumors: A demographic study of 759 cases in a Chinese population". They found a general predilection for mandible (mandible: maxilla ratio, 3.2:1) and this was particularly notable for ameloblastoma. In fact, 70.2% of the mandibular tumors were ameloblastomas as opposed to only 17.6% of the maxillary lesions. In contrast, COC and benign cementoblastoma occurred more commonly in maxilla and their respective maxilla-mandible ratios being 2.5:1 and 1.6:1. The odontogenic tumors in general most commonly occurred in the molar (27.9%) and angle regions (17.8%) of the mandible. AOT and COC were exclusively found in the anterior and the premolar regions of both jaws (adenomatoid odontogenic tumors, 88.9%; calcifying odontogenic cysts, 91.4%).

Santos et al in 2001[11] reported in their analysis of 127 cases that in general, the mandible was the most frequent affected site, corresponding to 54.33% of the cases, while the maxilla was affected in 40.15% cases. In their study, all the cases of ameloblastoma were exclusively located in the mandible. AOT and odontomas most frequently affected anterior maxilla whereas both the jaws were equally affected by myxoma.

Ochsenius et al in 2002 [12] studied 362 cases in Chile population. The mandible was a slightly more common site for occurrence for the total of benign odontogenic tumors, with a ratio of 1.14:1. It is worthwhile mentioning that the cases of CEOT and SOT were found exclusively in the maxilla. In general, odontomas were found in a greater number in the maxilla, especially in the anterior zone. The ameloblastic fibroma and ameloblastic fibrodentinoma were found only in the mandible. 81% ameloblastoma were observed in the mandible, most frequently in the molar zone.

Adebiyi et al in 2004[14] conducted analysis of 197 ectodermal odontogenic tumors in a Nigerian population. Of the lesions in which the site could be identified (163 cases), the majority occurred in the mandible (82.7%) with only 10 (5.1%) cases presenting in the maxilla. The site of the tumors was not indicated in 21 cases. Ameloblastoma occurred more frequently in the mandible (83.3%) than the maxilla (4.0%). The most common site of the mandible involved was the premolar-molar region (75cases, 70.1%). Four out of the five cases of SOT occurred in the mandible with only one presentation in the maxilla.

Tamme et al in 2004[15] conducted a collaborative retrospective study of 75 cases of odontogenic tumors, covering more than 25 years from Estonia. In general, there was a predilection for mandible (with a mandible to maxilla ratio of 1.6:1), which was particularly marked for ameloblastomas (mandible to maxilla 2.8:1). In contrast, 2 out of 6 cementoblastoma occurs in the maxilla; the maxilla to mandible ratio being 1:2. The most frequently affected areas were the premolar (20%) and molar regions (21.3%) in the mandible and the most common location in the maxilla was the premolar region (17.3%).

Adebayo et al in 2005[4] conducted a review of 318 odontogenic tumors in Kaduna, Nigeria. Posterior mandible was found to be the mostly affected site. For ameloblastoma, the symphysis- body ramus region of the mandible (n=144; 62%) was the most favored site for tumor occurrence, followed by anterior region of the mandible (n=66, 28%). In cases of CEOT, the posterior part of either jaw was the most common site. Odontogenic myxoma occurred more in the mandible (n=20, 53%) than maxilla (n=18, 47%).

Ladeinde et al in 2005[3] did a study titled "Odontogenic tumors: A review of 319 cases in a Nigerian teaching hospital". Mandible to maxilla ratio was 4.1:1. of the 319 cases, 308 tumors (96.6%) were located intraosseous, and 11 (3.4%) were peripheral. Among the peripheral lesions were 7 cases of peripheral odontogenic fibroma, 3 cases of peripheral myxoma and 1 of peripheral ameloblastoma. Malignant odontogenic tumors occurred more in the mandible than the maxilla (8:3). Generally all lesions were more prevalent in mandible except AOT and COC, which occurred more in maxilla.

Fernandes et al in 2005[17] did a study of 340 cases a Brazilian population. In their study exact location of the tumor was known in 319 cases. There were 110 (34.5%) cases in the maxilla and 209 (65.5%) cases in the mandible. The most frequently affected areas were the posterior aspect of the mandible and anterior region of the maxilla, with 56.9% and 60% of all the tumors found in each location, respectively. The ameloblastic fibroma was found only in the mandible. About 85% of the ameloblastoma were observed in the mandible, most frequently in molar zone. The complex and compound odontomas were found principally in the anterior zone of maxilla, with 61.5% and 63.6% cases of each respectively.

Buchner et al in 2006[18] did a study titled "Relative Frequency of Central Odontogenic Tumors: A Study of 1,088 Cases from Northern California and Comparison to Studies from Other Parts of the World". Both solid and unicystic types of ameloblastoma involved mandible more than maxilla.

The odontoma showed an almost equal distribution between maxilla (50.6%) and mandible (49.3%). Odontomas were most commonly encountered in anterior maxilla (37%), followed by anterior

mandible (25%), posterior mandible (25%), and the posterior maxilla (13%). COC showed no significant predilection for the location of the lesion either in the maxilla (53%) or the mandible (47%). Most lesions were in the anterior regions of the jaws (59%). The most common location was in the anterior maxilla (41.2%) followed by the posterior mandible (35.3%), anterior mandible (17.6%), and posterior maxilla (5.9%).

AOT showed an equal distribution of the tumors between maxilla (50%) and mandible (50%). Most lesions were in the anterior regions of the jaws (89%). The most common location was in the anterior maxilla (50%) followed by anterior mandible (39%), and then posterior mandible (11%). Ameloblastic fibroma showed a significant predilection for mandible (73%) in comparison to only 27% in the maxilla. For Odontogenic myxoma there was a significant predilection for the location of the lesion in the mandible.

Jing et al in 2006[19] did a study titled "Odontogenic Tumors: a retrospective study of 1642 cases in a Chinese population". 75.5% of the lesions were located in the mandible, especially in the molar (23.6%) and angle (23.5%) regions, with an overall maxilla: mandible ratio of 1:4.0. The most frequent tumor seen in the maxilla and the ramus of the mandible was keratocystic odontogenic tumor, and ameloblastoma was the most common tumor in the anterior, premolar, molar and angle regions of the mandible. Calcifying cystic Odontogenic Tumor (CCOT) showed a predilection for maxilla (63.9%), whereas most of the other odontogenic tumors were more common in the mandible. AOT and ameloblastic fibroodontoma occurred with an equal frequency (1:1 ratio) in the maxilla and the mandible.

Olgac et al in 2006[20] studied 527 cases of Odontogenic Tumors in Istanbul. The posterior mandible was the commonest site (n=184, 35%), followed by the premolar area of the mandible (n=98, 19%), and anterior maxilla (n=84, 16%). The mandible was more commonly involved by all tumors, as there were 351 cases in mandible and 176 cases in maxilla, the ratio being 1.9:1, and this was particularly prominent for ameloblastomas (mandible: maxilla ratio 7.8:1) and complex odontomas.

Most of the cases of compound odontomas were found in the maxilla, particularly in the anterior region. Odontogenic myxomas occurred equally in both jaws.

Okada et al in 2007[21] conducted a study titled "Odontogenic Tumors in Sri Lanka: Analysis of 226 Cases". The mandible (180 cases; 79.6%) was 3.9 times more frequently affected than the maxilla (46 cases; 20.4%). In the mandible, the most frequently affected region appeared to be the posterior part (109 cases; 60.6%) whereas, in the maxilla, it was the anterior part (22 cases; 47.8%). Most of the ameloblastomas (148 cases; 94.3%) occurred in the mandible (maxilla: mandible ratio, 1:16.4). In contrast, calcifying odontogenic cyst (2.3:1) and adenomatoid odontogenic tumor (1.3: 1) were more common in the maxilla. Furthermore, ameloblastoma showed a marked predilection for the posterior part of the mandible (100 cases, 63.7%), but adenomatoid odontogenic tumor was more common in the anterior part of both the maxilla and the mandible (a total of 15 cases, 9 in the maxilla and 6 in the mandible).

Sriram et al in 2008[22] retrospectively analyzed 250 cases of odontogenic tumors registered over a period of 36 years in an Indian teaching hospital in Mumbai, India. Mandible was clearly the most preferred site for occurrence of most of the odontogenic tumors, with a ratio of 3.8:1. Ameloblastoma showed a very high predilection for the mandible with 94.7% of the cases occurring in the mandible with a ratio of 18.1:1. In general, the odontogenic tumors were most commonly encountered in the posterior zones of the jaws, but AOT defied this general finding and preferably affected maxilla with a maxilla: mandible ratio of 2:1. Cases of odontogenic tumors that involved more than 2 areas of the jaws were AOT and ameloblastoma. A total of 22.8% of the mandibular ameloblastomas involved the full length of one-half of the mandible, and some extended to opposite side.

MATERIAL AND METHODS

This retrospective study is based on the data of all Odontogenic Tumors managed in Tamil Nadu Government Dental College and Hospital from February 1970 to March 2008. The histopathology record files from the Department of Oral and Maxillofacial Pathology were retrieved and reviewed retrospectively for all the cases diagnosed as odontogenic tumors during a period of 38 years (1970-2008). Out of the total 11,843 oral biopsies registered during this period, 498 cases were reported under odontogenic tumors. The clinical information with respect to patient's age, gender and anatomic location of the tumor was obtained from the biopsy records. The information regarding the extent of the lesion, radiographic interpretation and macroscopic details of the post surgical specimen were not available for most of the lesions, so these parameters were not included in our study. In the present study the odontogenic tumors were reviewed according to the 1992 WHO classification for odontogenic tumors (Annexure II).[28]

The hematoxylin and eosin stained slides of the respective cases were reviewed, and where necessary additional H&E sections were made by retrieving the available wax blocks from the department archives.

Using the Leica microtome, 4 micron meter thick sections were cut from the blocks for Ehrlich Hematoxylin and Eosin staining.

Procedure for Hematoxylin and Eosin staining[27]

- Sections are deparaffinised with xylene.
- Hydration with descending grades of alcohol.
- The sections are drained and transferred to hematoxylin, where they are left for 10 minutes.
- The slides are then drained and washed in running water until the sections are blue.

- The sections are dipped in acid alcohol where they are agitated for a few seconds and again washed in running water until blue again.
- The sections are counterstained with eosin for 30 seconds.
- The sections are washed in running water for 3-4 minutes, to differentiate the eosin.
- After draining, the sections are dehydrated in ascending grades of alcohol.
- The sections are cleared with xylol, where they are given two changes for 30 seconds each.
- The sections being clear, the slides are dried and mounted with Distrene 80 Dibutyl phthalate Xylol (DPX) under a coverslip.

The stained and mounted slides for all cases were examined under the light microscope to confirm the previous histopathologic diagnosis.

Results:

1. Nuclei: Blue

2. Cytoplasm: Varying shades of pink

The previously rendered diagnosis were re-evaluated and confirmed or modified. Based on this review, 9 cases did not qualify for the diagnosis of odontogenic tumors as they were considered to be other than odontogenic in origin and thus excluded from our study. In the case of recurrent tumors, the histology of the primary and the recurrent tumor were compared and they were considered as one case.

Attempts were made to identify the incidence of these lesions in similar teaching institutes in other parts of India in order to study the overall prevalence. In this context, a questionnaire regarding the prevalence study being conducted was sent through various sources of communication to various teaching hospitals including government and non- government institutions, across the country (annexure I). There are around 104 colleges in India offering MDS courses; of these, only 53 colleges conduct post graduation study in Oral Pathology[29]. From this, 25 colleges were short-listed on the basis that the oral pathology department in these colleges would be at least 10-20 years old to have sufficient

number of cases to be able to conduct a prevalence study. But the information provided was not sufficient enough for any meaningful contribution.

For the present study, distribution according to age, gender, and the prevalent location of each tumor, was determined. With regard to the site of occurrence, both maxilla and mandible were divided into 2 anatomic regions: anterior and posterior segments. In order to establish the changing pattern of tumor distribution in different age groups, the cases were categorized into decades. All the information and data were compiled and statistically analyzed using the SPSS for Windows statistical software. Statistical analysis of the relation between different variables was performed using the chi-square test and ANOVA followed by Student-Newman-Keuls test. The critical level of significance was set at $P< 0.05$.

The P value between 0 to 0.01= the observation/result is significant at 1% level.

The P value between 0.011 to 0.05= the observation/result is significant at 5% level.

The P value >0.05= the observation/result is not significant at 5% level.

OBSERVATIONS & RESULTS

This retrospective study was conducted to review the 498 cases diagnosed as odontogenic tumors out of 11,843 oral biopsies registered in the records of Oral Pathology Department of Tamil Nadu Government Dental College, Chennai. After reviewing the H & E stained slides, 9 cases were excluded from our study population as they were found to be non-odontogenic in origin. The 489 cases constituted 4.13% of all oral and maxillofacial pathology biopsy specimens managed during a period of

38 years.

PATIENT VARIABLES

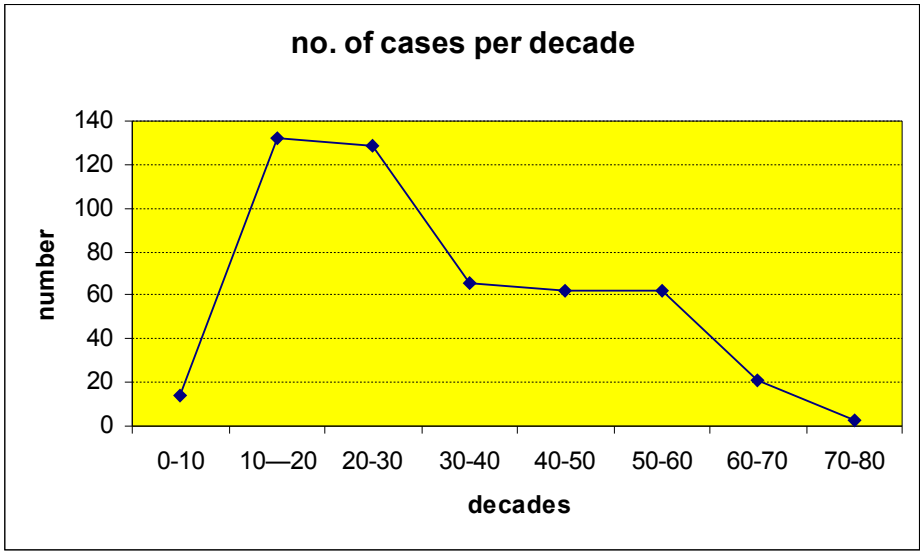
Age distribution:

The odontogenic tumors in this study population affected the patients over a wide age range of 5 - 75 years with a mean age of 32.64 years. Age distribution of all 489 cases showed a peak occurrence in 2nd and 3rd decade of life with 53.17% of the cases in these decades.

Table 1: Distribution of patients by age group (in decades)

Age in decades	No. of patients	Percentage
0-10	14	2.86
11-20	131	**26.79**
21-30	129	**26.38**
31-40	66	13.50
41-50	61	12.47
51-60	63	12.88
61-70	22	4.49
71-80	3	0.61

Fig.1

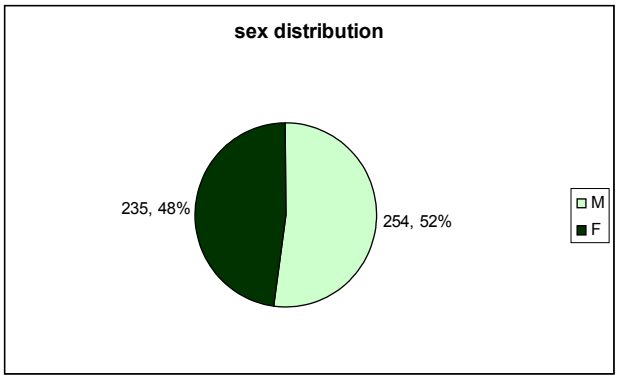


Gender distribution:

Gender analysis of the patient population showed a slight male predilection. Among the 489 cases, 254 were male (51.94%) and 235 (48.06%) were female patients, with an overall M: F ratio of 1.08:1.

Table 2: Distribution of patients by gender:

Fig. 2

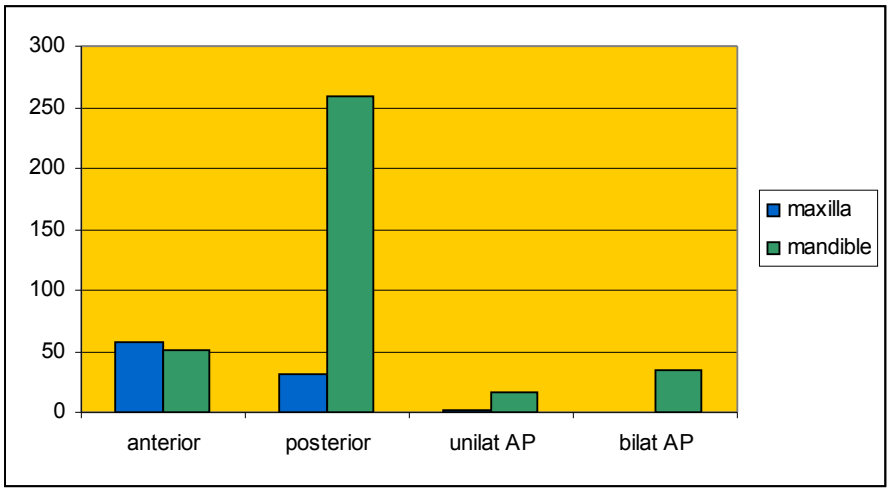


Site distribution:

The mandible was clearly the most commonly affected site for most of the odontogenic tumors with 362 cases (74.02%) occurring in the mandible. Mandible was 4 times more frequently affected than the maxilla (90 cases; 18.4%). In the mandible, the predominantly affected region appeared to be the posterior part (259 cases; 71.54%). In the maxilla, it was the anterior part (57 cases; 63.33%) that was prominently involved. The site of involvement of lesions was not specified in 28 cases.

Table 3. Distribution of patients according to the sites of involvement:

Fig. 3



VARIABLES RELATED TO INDIVIDUAL ODONTOGENIC TUMORS

Incidence of odontogenic tumors over decades (1970-2008):

The incidence of odontogenic tumors was assessed in four decades from 1970-2008. Our study shows a sudden increase in the number of cases from 1970-1980 to 1981-1990 correlating with the increase in number of total received biopsies. In the following decade there is an increase in the number of the odontogenic tumors even though the total number of received biopsies is relatively lesser. Our study also reveals a trend towards increase in both the number of total cases and odontogenic tumors in the recent years.

Fig.4

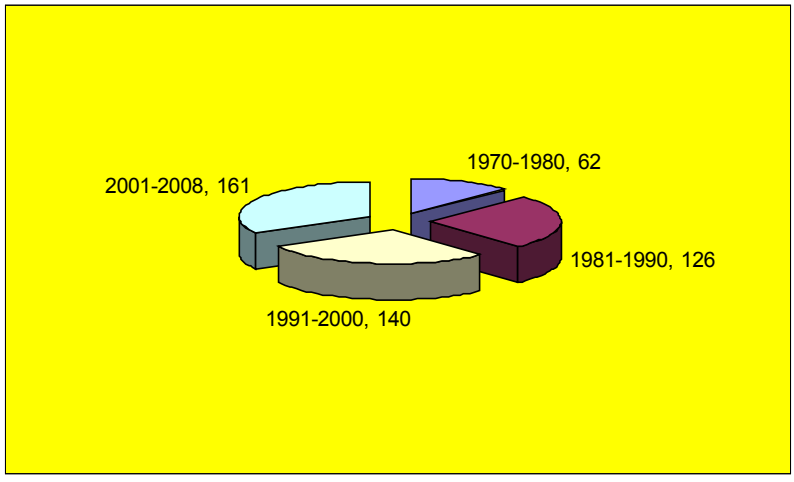


Table 4:

Frequency of odontogenic tumors over 4 decades (1970-2008):

Year in decades		Odontogenic Tumors per decade	Total No. of cases per decade	Incidence rate %
1970 – 1980	Benign	62	2029	3.05%
	Malignant	0		
	Total	**62**		
1981 – 1990	Benign	124	3132	4.02%
	Malignant	2		
	Total	**126**		
1991 – 2000	Benign	133	3057	4.57%
	Malignant	7		
	Total	**140**		
2001 – 2008	Benign	155	3625	4.44%
	Malignant	6		
	Total	**161**		
Total		489	11843	4.13%

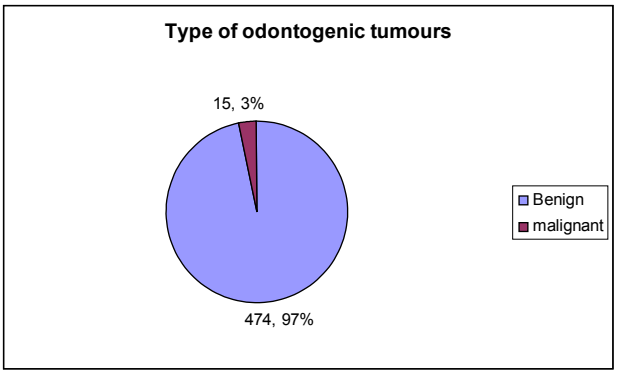
Of these 489 cases, 474 cases (96.93%) were benign tumors and 15 cases (3.07%) were malignant.

Table 5:

General frequency of odontogenic tumors:

Odontogenic Tumors	Number of patients	Percentage
Benign	474	96.93
Malignant	15	3.07
Total	489	100

Fig.5



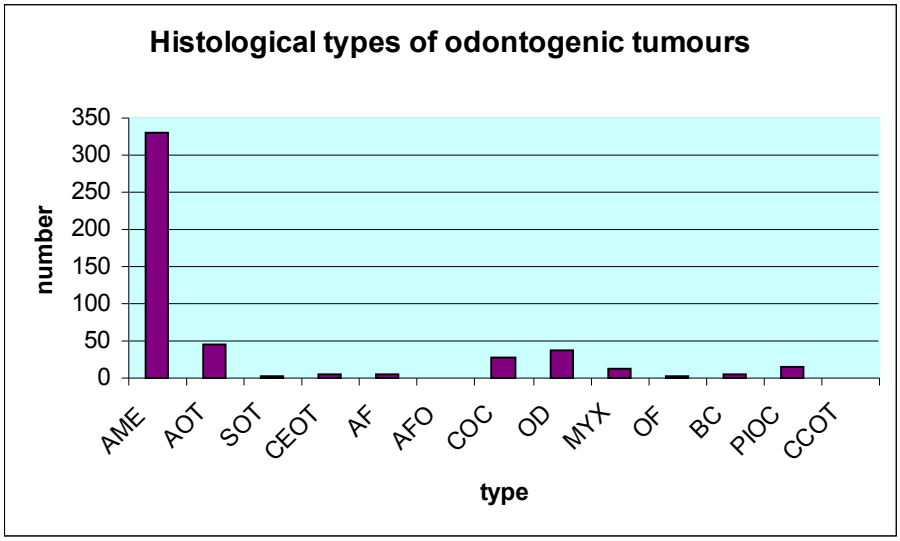
Of the benign tumors, ameloblastoma was the most frequently observed lesion accounting for 67.68% (n=331), followed by AOT (n=44, 9%), odontomas (n=38, 7.77%), COC (27cases, 5.52%), and odontogenic myxoma (n=13, 2.65%). Of the 38 odontomas, 27 were complex and 11 were compound odontomas in nature. All the malignant tumors were found to be primary intraosseous carcinomas (n=15, 3.06%).

Table 6: The distribution of histological types of odontogenic tumors:-

~~Of the benign tumors, ameloblastoma was the most frequently observed lesion accounting for 67.68%~~

~~(n=331), followed by AOT (n=44, 9%), odontomas (n=38, 7.77%), COC (27cases, 5.52%), and odontogenic myxoma (n=13, 2.65%). Of the 38 odontomas, 27 were complex and 11 were compound odontomas in nature. All the malignant tumors were found to be primary intraosseous carcinomas (n=15, 3.06%).~~

Fig. 6



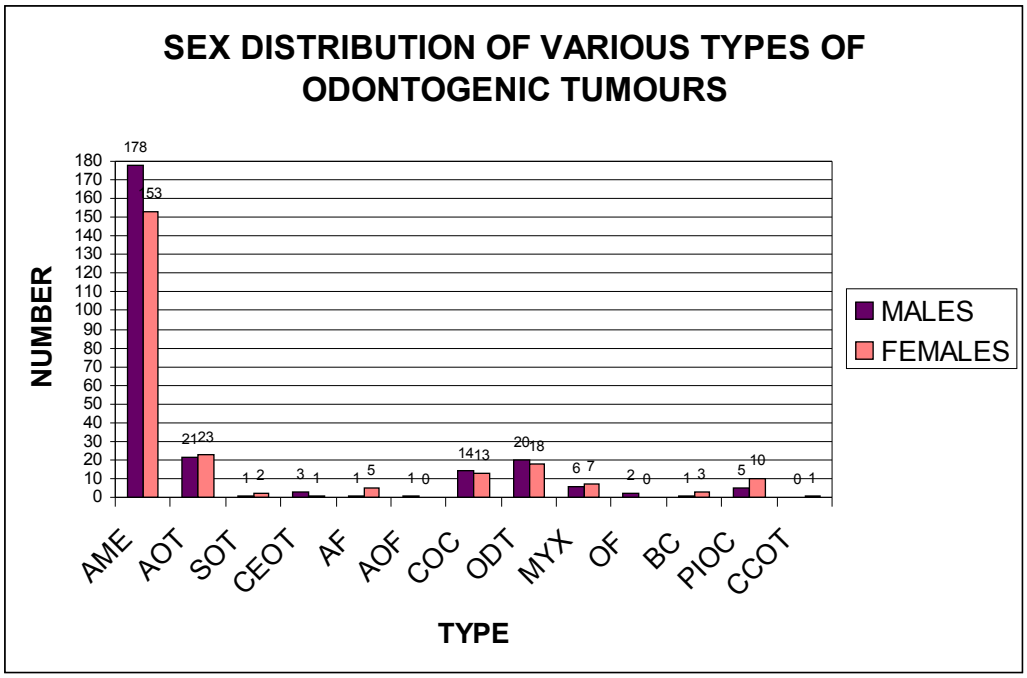
Gender distribution of individual odontogenic tumor:

Of the 474 cases of benign tumors, 249 (52.53%) were diagnosed in male patients and 225 cases (47.46%) were in female patients (the M: F ratio being 1.1:1). Ameloblastomas, odontomas and CEOT affected male patients more than female patients, whereas AOT, squamous odontogenic tumor, benign cementoblastoma and ameloblastic fibroma were seen more in female patients. Further observation showed that malignant odontogenic tumors were 2 times more common in females than male patients, as of the 15 cases, 10 were female patients and 5 were male patients (the M: F ratio being 1:2).

Table 7: The distribution of individual odontogenic tumors according to gender:

Odontogenic tumors	Males (n)	Percentage %	Females (n)	Percentage %	M:F ratio
AME Solid -207 Unicystic- 117 Peripheral- 7 Total- 331	 119 54 5 178	 57.48 46.15 71.42 53.77	 88 63 2 153	 42.51 53.84 28.57 46.22	 1.16:1
AOT-44	21	47.72	23	52.27	1:1.09
SOT-3	1	33.33	2	66.66	1:2
CEOT-4	3	75	1	25	3:1
AF-6	1	16.66	5	83.33	1:5
AOF-1	1	100	0	_	1
COC-27	14	51.85	13	48.14	1.07:1
ODT-38 ODTd ODTx	20 6 14	52.63	18 5 13	47.36	1.11:1
MYX-13	6	46.15	7	53.84	1:1.16
OF-2	2	100	0	_	2
BC-4	1	25	3	75	1:3
CCOT-1	0	_	1	100	1
PIOC-15	5	33.33	10	66.66	1:2

Fig.7



Ameloblastoma, the most common tumor in this study showed a peak occurrence with 100 out of 331 cases (30.21%) in 3rd decade and almost equal number of cases in 2nd, 4th and 5th decades. It was observed that in younger age group (2nd decade), relatively more number of patients were affected by unicystic ameloblastoma than solid ameloblastoma. AOT, the second most common tumor in this series, showed a peak incidence in 2nd decade, with 33 out of 44 cases (75%) occurring in 2nd decade. AOT affected patients between the age range of 9 to 30 years with a mean age of 16.84 years. Odontomas also predominantly occurred in 2nd decade with 24 of 38 cases (65.78%) in this age group. Ameloblastic fibroma mainly affected younger patients as 4 out of 6 cases were seen in 1st and 2nd decade. Primary intraosseous carcinoma occurred more in older patients (6th decade).

Table 8: <u>The age distribution of individual odontogenic tumors according to decades:</u>

Site distribution of individual odontogenic tumors:

Four hundred and eighty cases (98.15%) of all odontogenic tumors were intraosseous whereas only 9 lesions (1.85%) were extraosseous or peripherally located. The peripheral lesions included 1 case of AOT, 1 of odontogenic fibroma and 7 cases of ameloblastoma.

Table 9:

Odontogenic Tumors	**Number of patients**	**Percentage**
Intraosseous	480	98.15
Peripheral Ameloblastoma Odontogenic fibroma AOT	9 7 1 1	1.85
Total	489	100

Ameloblastoma showed a very high predilection for the mandible with 90.33% of the cases occurring in the mandible (mainly posterior region). The mandible: maxilla ratio being 12:1 for ameloblastoma. Odontogenic myxoma (46.15%), ameloblastic fibroma (83.33%) and PIOC (93.33%) also occurred more in posterior mandible. In contrast to the general mandible predominance shown by all other tumors, maxilla was predominantly affected by AOT with 29 out of 44 cases occurring in the maxilla (mainly anterior region). 44.73% of odontoma cases occurred in anterior maxilla and34.21% in posterior mandible.

Table 10: The distribution of individual odontogenic tumors according to anatomic location:

Individual tumors:

Three hundred and thirty one cases were diagnosed as ameloblastoma, which corresponded to the most frequent odontogenic tumor, accounting for 67.7% of all cases. The lesion predominantly affected males (178 cases) with an M: F ratio of 1.16:1. The majority of the lesions occurred in mandible (299 cases) and only 25 cases were seen in maxilla, with a mandible: maxilla ratio being 12:1. In both the maxilla and the mandible, posterior region was mainly affected. The highest incidence was observed in 3rd decade of age with 30% cases, whereas 2nd, 4th, 5th and 6th decades were involved with almost an equal frequency of 16% cases in each decade. Ameloblastoma affected patients over a wide age range of 5-75 years with the mean age of 35.69 years. There were 207 cases of solid type, 117 of unicystic type and 7 were peripheral ameloblastomas. The peripheral ameloblastoma constituted 2.11% of all ameloblastomas, Of the 7 peripheral cases, 5 occurred in anterior regions (3 in anterior mandible and 2 in anterior maxilla) and only 2 in posterior regions (one each in maxilla and mandible).

AOT was the second most common lesion in this series, as 44 cases (9%) of AOT were identified in this study. The lesion occurred in 21 males and 23 females. The patients were affected the most in their 2nd decade of life with a mean age of 16.84 years. The most commonly affected site was anterior maxilla with 27 out of the 44 cases in this region. Fourteen cases were found in the mandible, and of the 14 cases, 10 cases were present in anterior mandible and 4 cases in posterior mandible. Majority of the cases (n=31, 70.45%) were follicular variants of AOT, associated with an impacted tooth (mostly maxillary canine), whereas only 12 cases (27.27%) were the extrafollicular type. The rare peripheral type (2.27%) occurred in anterior maxilla.

Thirty eight cases of odontomas were identified, constituting 7.77% of the study population. There were 27 (71.05%) complex and 11 (28.95%) compound type odontomas. The highest incidence was observed in 2nd decade of life with 24 (65.78%) out of 38 cases in this group and mean age of 17.81 years for compound and 24.46 years for complex odontoma. The youngest patient to present with the lesion was 7 year old with compound odontoma and the oldest was 67 years old with a complex odontoma. The lesion affected 20 male and 18 female patients. The predominantly involved segment was anterior maxilla with 17 cases in this region, followed by 13 cases in the posterior mandible.

Thirteen cases of odontogenic myxoma were found, corresponding to 2.65% of all the odontogenic tumors. This lesion affected both sexes almost equally (6M: 7F) with no gender predilection. Mandible was predominantly involved with 10 cases in mandible, mainly the posterior region -and only 3 cases in maxilla. 69% of the cases were seen in 2nd and 3rd decade with a mean age of 24 years.

Ameloblastic fibroma, representing 1.22% of all odontogenic tumors in our study was an uncommon tumor type, affecting 6 patients over an age range of 6-40 years with a mean age of 19.83 years. Females were predominantly affected, and M: F ratio being 1:5. Of the 6 cases, 5 (83.33%) were present in posterior mandible and only one case in anterior maxilla.

Fifteen cases (3.06%) were diagnosed as primary intraosseous carcinomas, the only type of malignant tumor seen in this series. This malignancy affected females (10 cases) two times more than male patients (5 cases). The patients ranged in age from 21 to 75 years with a mean age of 57.93 years. Majority of cases occurred in 6th decade of ~~life~~life. The neoplasm was seen exclusively in the posterior segments of both the jaws.~~, and the~~The posterior mandible was clearly the most frequently affected site with 14 out of 15 cases in this region, - and only one cases in posterior maxilla. -

Other odontogenic tumors included three squamous odontogenic tumors (0.6%), four cases each (0.8%) of benign cementoblastoma and calcifying epithelial odontogenic tumor, two cases (0.4%) of odontogenic fibroma, and one each (0.2%) of ameloblastic fibro-odontoma and clear cell odontogenic tumor.

RELATION BETWEEN DIFFERENT VARIABLES RELATED TO ODONTOGENIC TUMORS

Age –Sex Correlations:-

Further observations revealed that in 2nd, 4th, and 6th decades there were more female patients than male patients, whereas in 1st, 3rd, 5th, 7th, and 8th decades male patients predominated.

Table 11.

Age in decades	No. of cases per decade	No. of male patients	No. of female patients	M:F Ratio
0-10	14	9	5	1.8:1
11-20	131	**59**	**72**	1:1.2
21-30	129	70	59	1.18:1
31-40	66	**29**	**37**	1:1.27
41-50	61	39	22	1.77:1
51-60	63	**28**	**35**	1:1.25
61-70	22	18	4	4.5:1
71-80	3	2	1	2:1

The $\chi 2$= 18.14525, P=.00588 i.e.> 0.005**denotes the significance at 5% level.

The table 12 shows the difference in the mean ages of occurrence of individual lesions in male and female patients, which was not found to be statistically significant except for compound odontomas.

Table 12.

Odontogenic tumors	Mean age (in years)	
	Male	Female
Ameloblastoma		
Unicystic	33.33	32.22
Solid	38.68	35.74
AOT	17.14	16.56
Ameloblastic Fibroma	22	19.4
Odontogenic myxoma	20.83	27.14
Compound Odontoma	12.83	23.8
Complex Odontoma	25.5	21.46
PIOC	57.6	58.1

Age-Site Correlations:-

Table 13.

Age in decades	Total no. of cases	Mandible	Maxilla	Peripheral	NS
0-10	14	**4**	**7**	3	0
10-20	131	86	39	1	5
20-30	129	93	21	1	14
30-40	66	58	3	1	4
40-50	61	47	9	2	3
50-60	63	53	8	0	2
60-70	22	19	3	0	0
70-80	3	2	0	1	0

Table 13 depicts the correlation between the various anatomical sites affected in different age groups. The statistical analysis revealed a significant difference as mandible was the mostly affected site in all other decades (P<0.001**) except in first decade when more lesions were seen in the maxilla than in the mandible.

Table 14.

Age	Anterior Maxilla	Posterior Maxilla

0-10	6	1
11-20	34	5
21-30	13	8
31-40	2	1
41-50	1	8
51-60	1	7
≥60	0	3

Table 14 shows that as the age increases, the site of involvement changes and in older patients lesions occur more in posterior than anterior regions. This observation was statistically significant, P<0.001**.

Table 15.

Type of lesions	**Age**	
	Mean	**SD**
Malignant	57.93	12.56
Benign	31.84	15.95

The mean age of the patients affected by benign odontogenic lesions was significantly lower than the mean age of patients with malignant odontogenic tumors (P< 0.001**).

Table 16.

Type of the lesions	**Age**	
	Mean	**SD**
AME	35.70	15.49
AOT	**16.84**	4.74

COC	32.59	15.88
OD	21.89	13.21
MYX	24.23	11.93
CEOT	21.25	11.62
PIOC	57.93	12.56

The difference in the mean age of the above stated lesions was found to be statistically significant (P<0.001**) as the mean age of patients with AOT was significantly lower than the mean age for other lesions.

Sex- site correlation:-

Table 17.

Gender	Mandible	Maxilla	Peripheral	N/S
Male	186	47	6	15
Female	176	43	3	13

$\chi 2$= .85993, P=.83508 means P>0.05 so statistically not significant, means that the difference in the relative number of sites involved in male and female patients was not statistically significant.

Table 18.

The above two tables depict the correlation between the affected sites among males and females. The statistical analysis revealed no significant difference between site of involvement among male and female patients [P=0.835,(, (P>0.05)].

DISCUSSION

The results of the present study showed that odontogenic tumors occur at a frequency of 4.13% of the total biopsied specimens registered in the department. It also revealed a gradual increase in the number of cases recorded (62/2029 cases) in the first decade with a percentage of 3.05% compared to a higher number of cases (161/3625 cases) during the current decade with 4.44%.

The great bulk of the odontogenic tumors were ameloblastomas, which comprised a total of 331 cases (67.68%) out of a total of 489 odontogenic tumors. The ameloblastomas were grouped into central (97.88%) and peripheral lesions (2.11%). Within the central lesions they were sub classified into solid (63.88%) and unicystic (36.11%). Solid ameloblastoma formed a total of 207 cases with an overwhelmingly higher proportion of the cases found in the mandible (90.33%) than the maxilla. The second most prevalent tumor was the AOT with 44 cases (43 intraosseous and 1 peripheral, 9%) followed by odontomas (38 cases, 7.7%), COC (27 cases, 5.5%), PIOC (cases 15, 3%) and odontogenic myxoma (13 cases, 2.6%). The rest included clear cell odontogenic tumor, ameloblastic fibroodontoma, odontogenic fibroma, SOT, benign cementoblastoma, CEOT and AF between 1-6 cases. Over 50% odontogenic tumors were found in the second and third decades of life.

The single most frequent site of involvement for odontogenic tumors was the mandible (362 cases, 74.03%). The overall gender distribution of odontogenic tumors showed a slight male predilection with 51.94% (254/489 cases) in males and 48.06% (235/489 cases) in females.

Information derived from the literature indicates that large published series on odontogenic tumors from Indian population is limited to a single publication.[22] Literature search also revealed no other published series on odontogenic tumors in the adjoining countries like Bangladesh, Bhutan, Myanmar, Nepal, and Pakistan except a single report from Sri Lanka.[21] The present study, on the

descendants of the Dravidian race concentrated at the tip of India, Chennai, Tamil Nadu, is based on a larger sample (489 cases) of odontogenic tumors among the population registered in the Department of Oral & Maxillofacial Pathology of the Tamil Nadu Government Dental College & Hospital, Chennai, Southern India. This study on a sample size of 489 cases spread over a period of 38 years (1970-2008) represents the single largest series from this part of the world.

The epidemiological data regarding the overall global prevalence of odontogenic tumors vary among different geographical locations and populations from as low as 0.74% to as high as 32% (annexure III & IV). This wide variation may be partly attributed to the variation in the parameters employed by researchers around the world. This is evident from the fact that some researchers have included only central lesions in their analysis, while others have included peripheral lesions[3,11] or disregarded odontomas.[42] Still others have addressed either only benign odontogenic tumors[46] or tumors of ectodermal origin,[14] and on occasion, only peripheral odontogenic lesions.[30,49] Further more, the variations may be related to the differences in arriving at the overall percentage of prevalence, where some studies have considered prevalence of odontogenic tumors as a percentage of all tumor and tumor-like lesions of the oral and peri-oral regions. [2,4,8,13,16,20] In the present study, like many other studies, [3,9-12,15,17,18] odontogenic tumors were considered as a percentage of the total biopsied samples.

The incidence of 4.13% of odontogenic tumors found in the present study although higher compared to studies from American population, [9,12,18] is substantially lower compared to reports (8.6-32%) from the studies on African population. [2,3,4,7,8,24,25,26] Odontogenic tumors were found in patients over a wide age range of 5-75 years with a mean age of 32.64 years. They were found to be most frequent in the second through sixth decades with peaks in the second and third decades of life. The high number of ameloblastomas found in this study, like the observation made by Ladeinde et al, [3] Fernandes et al [17] and Okada et al, [21] might have invariably contributed to the higher prevalence of odontogenic tumors in the second and third decades of life. Similar observation of high prevalence of odontogenic tumors in the second decade were also observed by Santos et al [11]and Tamme et al, [15] but

this was perhaps more due to the number of odontomas in their study. Other studies [4, 8, 10, 14,16,19,22] have reported prevalence in the third decade of life; again, the ameloblatomas formed the bulk of the cases in that age group. Still others have assessed the prevalence of odontogenic tumors in childhood and adolescence, restricting the scope for any meaningful comparison. [24,25,42,47]

The sex predilection for odontogenic tumors is equivocal in the literature. The present study revealed a slight male predominance (Male: Female=1.08:1). This figure is comparable with many series, [2,3,4,6,8,10,14,19,22] though others have found a female predominance. [9, 11, 12, 15, 17, 20, 21]

There is still a lack of agreement on the most frequently encountered type of odontogenic tumors. The most prevalent tumor in the present study was ameloblastomas similar to the previously reported series from African and other Asian populations. [2,3,8,10,14,16,17,19-24] Even in the American population, [9,12,15,18,25] ameloblastoma were still the most frequent odontogenic tumor, especially when odontomas were disregarded. Our study identified AOT to be the second most frequent odontogenic tumor with 44 cases (9%) followed by a marginally less number of 38 cases (7.7%) of odontomas and COC (27 cases, 5.5%).

There is general consensus among researchers with regard to the most afflicted site of odontogenic tumors. In the present study, mandible was the predominantly affected site with 362 cases as opposed to 90 cases in the maxilla with the maximum number of cases concentrated in the posterior region (259 cases). This observation is shared by many previous studies. [2-4, 6-25] The anterior segment of the maxilla (57 cases) was affected more often compared to the anterior segment of the mandible (51 cases). The lesions that were found to occur more in the anterior maxilla were AOTs (26 cases) and odontomas (17 cases). On the other hand, ameloblastomas were identified more frequently in the anterior mandible (30 cases). The predominance of AOT in the anterior maxilla, observed in the present study, is similar to the observation noted on African and other Asian populations. [4,8,10,21,22,24] The higher prevalence of ameloblastomas in the anterior mandible observed in the present series is comparable to the reports from studies on Brazilian, African and Asian populations, [4,8,10,17,19,21,22,24] while

results of the European and American studies [9,11,12,15,20] have shown odontomas to be the most prevalent odontogenic lesion in the anterior segment of both the maxilla and mandible.

The interpretations of the above observations indicate that ameloblastoma is the most frequent odontogenic tumor, when odontomas are excluded, irrespective of ethnic or geographic populations.

In the context of Indian population only one published report involving a considerably large series spanning over decades is available for comparison to elicit subtle differences. The report by Sriram & Shetty, [22] involving largely Maharastrian population in one of the most populated metropolitan cities in India, revealed that ameloblastoma is the most frequent odontogenic tumor akin to our observation and others. Their study also found ameloblastoma to be more frequent in the mandible than the maxilla with a ratio of 18.1:1. The ratio for mandible to maxilla found in our study was 12:1. When all ameloblastomas were considered the mandible was affected in 90.33% of cases in our series. But when the percentage of ameloblastoma was arrived for intraosseous lesions the result was 92.28% as opposed to a marginally higher value of 94.7% observed by Sriram & Shetty.[22] The incidence of central ameloblastoma with 66.25%, observed in the present study, is more than the 61.6% observed in their study, and the total number (331) of ameloblastoma represents the largest single institutional study in Tamil linguistic people of Dravidian origin in India. Moreover, our study revealed 63.88% (207 cases) to be of solid ameloblastoma while 36.11% (117 cases) were of unicystic ameloblastoma, when intraosseous ameloblastoma were exclusively taken into consideration. The global frequency of unicystic ameloblasoma was in the range of 6% - 32%. Our figure of 36.11%, although high, is close to that reported by Okada et al [21] (31.41%) for the Sri Lankan population. There was more number of solid ameloblastomas in the mandible with 62.54% as opposed to 37.45% for unicystic ameloblastoma. When the anterior region of the jaws was considered for both variants of central ameloblastoma, the incidence of 11.72 % was significantly more than the 7.2% observed by Sriram & Shetty.[22] The value obtained for Dravidian population in the present study is in agreement with the observation made by Riechart et al.[50]

Our study also noted differences between gender groups with regard to ameloblastoma subtypes; solid ameloblastoma occurred more frequently in males, whereas unicystic ameloblastoma showed predilection for females. Although our observation of a female predominance for cystic ameloblastoma is consistent with Buchner et al[18] & Okada et al, [21] others have observed a male predilection.[34,35,36]

In the present study more cases of unicystic ameloblastomas were seen in the second decade than solid ameloblastomas. The mean age of occurrence of ameloblastomas was 37.4 years for solid ameloblastomas and 32.7 years for unicystic ameloblastomas (117/324 cases) but was only 23.11 years for unicystic ameloblastoma that were associated with an unerupted tooth (17/117 cases). The second and third decade involvement by unicystic ameloblastoma has also been reported in the literature.[34,35] Peripheral ameloblastoma constituted **2.11%** of all ameloblastomas similar to the data found by Reichart et al.[50] They occurred more in the incisor molar-premolar region than in the molar-ramus region. In general, posterior region of the mandible was the preferred site for both unicystic and solid ameloblastomas but peripheral ameloblastoma tend to occur more anteriorly.

The AOT was the second most common odontogenic tumor (44/489 cases) encountered in our study. It was termed as AOT by Philipsen & Birn.[39] AOT can exist in 3 clinico-topographic variants namely, follicular, extrafollicular and peripheral. The relative incidence of this entity ranges from 0.6% to 38.5% and is more prevalent in the African population than elsewhere.[41] In the present analysis, although 1/3 (14/44 cases) of AOT occurred in the mandible, it was the most common tumor in the maxilla with an incidence of 6%, and an overall prevalence of 9% in both jaws. The other reports from India and the neighboring Sri Lanka,[21,22] like our observation in the Tamil linguistic people of Dravidian origin, indicated that AOT has more probability of occurrence in the maxilla than any of the odontogenic tumors, especially in younger individuals. It also revealed that AOT is the second most frequently encountered odontogenic tumor in India and Sri Lanka.[21,22] In our study AOT affected patients in the age range of 9 to 30 years with a mean age of 16.84 years. The mean age found in the

Dravidian population was comparatively lower than the mean age of 18.2 years and 19.4 years, reported by the Sri Lanka[21] and the Maharastrian population in India, [22] respectively.

Though the literature[41] showed AOT to be most frequent in females, gender involvement was almost equal with regard to the occurrence of follicular variants of AOT (15 females, 16 males) but slightly more extra follicular variants were found in females (7/43 cases) than in males (5/43 cases) in our analysis. In the present study, **75%** of AOT occurred in younger patients (2nd decade) similar to other series.[3,4,8,10,11,17,19,21,22,39] However, when compared to ameloblastomas (mean age, 35.69 years), the mean age for AOT was found to be quite low, i.e., 16.84 years. The difference is statistically significant (Table 12).

Assessment of the exact frequency of odontomas is complicated by the fact that it is omitted in some analysis. Yet the literature shows a significant difference as to the relative frequency of odontomas that varied between Nigerian[3] and North California[18] populations with 2.5% to 76%, respectively. The extreme variations in the frequency of odontomas could possibly suggest a racial affect, in that its prevalence was low in the African and other Asian populations[2-4,8,10,16,21-24] compared to others.[9,11,12,15,17,18,20,25] In the present study the frequency of odontomas was 7.8% which is comparably higher than China (6.7%), [10] other Indian study (6%), [22] and Sri Lanka (4.4%).[21]

Odontomas in the present study showed a slight male predominance, similar to the observation by Fernandes et al,[17] Buchner et al,[18] & Olgac et al.[20] It occurred mostly in younger individuals with a mean age of 21.89 years. Over 65.8% were found in individuals less than 20 years of age but patients afflicted with compound odontomas (mean age, 17.81 years) were considerably younger than those with complex odontomas (mean age, 24.46 years). These observations are consistent with the reports from elsewhere.[10,12,15,17,19,21] Complex odontomas tend to occur more frequently than the compound type, an observation in agreement with most others. [10,12,15,17,19,20] The reverse trend was noted in one single study.[21] The tendency to occur in the anterior region (57.9%) was more than the posterior region (42.1%) of both the jaws. Similarly, the anterior maxilla was the preferred site followed by posterior

mandible and posterior maxilla. Unlike the Sri Lankan study, [21] where more compound odontomas were found in the anterior mandible, compound odontomas in the present series tends to occur more often in the anterior maxilla, while complex odontomas were found in the posterior mandible. These observations are shared by some but not others.[9,10,11,12,17,19,20,22] The study on the Maharastrian population in India[22] which although did not specify the type, have found more odontomas in the posterior mandible.

COC represents 5.52% with 27 cases. The male to female ratio was found to be 1.07:1 with 51.85% in males and 48.14% in females. The mandible was the most frequently involved site in over 74% of cases. When the ratio of ameloblastoma to COC was assessed, the ratio of 12:1 was found to be lower compared to the observation by Sriram and Shetty[22] (22:1). When only the unicystic ameloblastomas were compared, the difference narrowed to a ratio of 4.3:1, similar to the Sri Lankan Study.[21] in the present study the mean age (32.59 years) and peak incidence for COC was similar to that found for unicystic ameloblastomas, while COC tend to occur more frequently in males. The mean age and male predilection observed in the present study was at variance with the observation made by Sriram and Shetty[22] but concurs with the Sri Lankan study.[21]

Odontogenic myxoma was first described by Thoma and Goldman in 1947. It is unique to the jaws and has predilection for the posterior region, and occurs at a relatively younger age group compared to ameloblastoma. There have been only few published series involving a significantly large number of patients. The frequency of 2.65% odontogenic myxoma in the present analysis was comparable with others. However, no significant gender distribution was noted in the present series. The mean age of 24.23 years for odontogenic myxoma was significantly lower than that for ameloblastoma (35.7 years) in the present series, and was in agreement with Sriram and Shetty.[22] The frequency of this tumor in the mandible than in the maxilla (3.33:1) was comparable to most other reports but was at variance with Sriram and Shetty (1:1). This indicated that maxillary odontogenic myxomas were uncommon in the population groups studied by us.

Ameloblastic fibroma and ameloblastic fibro-odontoma comprised a total of 7 cases with six of the former and a single case of the latter, which together formed less than 1.5% of the sample. The low prevalence of these childhood odontogenic tumors in our sample correlated with Sriram and Shetty,[22] as well as by others (annexure IV). An exceptionally high prevalence of 16 %, however, was found in an Estonian series.[15] Both AF and AFO occurred mainly in the posterior region of the mandible with a single case of the former in the anterior maxilla. The predilection for posterior mandible was almost similar in both the Dravidian population of our study and Maharastrian population of Sriram and Shetty. In the neighboring Sri Lanka where a substantial Dravidian population exists, the anterior maxilla was the most frequently involved site. While AF occurred in the age range of 6-40 years, the single case of AFO was found in a 5 year old boy. The mean average age of patients affected by AF was 19.83 years with a male: female ratio of 1:5. The female predominance was in agreement with other reports.[6,8,11,12,15,17,19,21,22] Contrary to our observation, Slootweg in an analysis of 55 cases, found a lower mean age of 14.6 years and a slight male distribution (52.7%). A higher mean age was observed by Sriram and Shetty (26.5 years) and in an Estonian series (39.2 years).[15,22] The varied results need to be addressed by further investigation by others, especially in the Indian context.

The lesser number of other benign odontogenic tumors were negligible to draw any meaningful observation. The present analysis found no malignant ameloblastoma or ameloblastic carcinoma, especially in the setting of high frequency of ameloblastoma in our study. In fact three cases were coded as ameloblastic carcinoma but on review were found to be salivary gland adenocarcinomas. PIOC was the only malignant entity encountered in this analysis and represents 3.06% (15 cases) of odontogenic tumors. It was found to occur more in females and in the posterior mandible.

.

SUMMARY

The present study was designed to analyze the epidemiological information on odontogenic tumors of those patients who had undergone biopsy and whose data are registered in the Department of Oral Pathology & Microbiology, Tamil Nadu Government Dental College and Hospital, Chennai, in the state of Tamil Nadu, India; to provide the data in the context of patients age, sex, site and histopathological diagnosis for comparison with other studies and for future research purpose. The retrospective study was conducted on a sample size of 489 cases diagnosed as odontogenic tumors out of the total 11,843 oral and maxillofacial biopsies registered in the Department of Oral Pathology over a period of 38 years (February 1970 to March 2008). The results of the present study can be summarized as below:

The 489 cases constituted 4.13% of all the biopsy specimens registered over a period of 38 years. Our study also revealed a gradual increase in the number of cases recorded (62 odontogenic tumors /2029 total cases) in the first decade (1970-1980) with a percentage of 3.05% compared to a higher number of cases (161/3625 cases) during the current decade (2001-2008) with 4.44%.

The great bulk of the odontogenic tumors were ameloblastomas, which comprised a total of 331 cases (67.68%) out of a total of 489 odontogenic tumors. The ameloblastomas were grouped into central (97.88%) and peripheral lesions (2.11%). Within the central lesions they were sub classified into solid (63.88%) and unicystic (36.11%). Solid ameloblastoma formed a total of 207 cases with an overwhelmingly higher proportion of the cases found in the mandible (90.33%) than the maxilla. The second most prevalent tumor was the AOT with 44 cases (43 intraosseous and 1 peripheral, 9%) followed by odontomas (38 cases, 7.7%), COC (27 cases, 5.5%), PIOC (cases 15, 3%) and odontogenic myxoma (13 cases, 2.6%). The rest included clear cell odontogenic tumor, ameloblastic fibroodontoma, odontogenic fibroma, SOT, benign cementoblastoma, CEOT and AF between 1-6 cases.

The odontogenic tumors in this study population affected the patients over a wide age range of 5 - 75 years with a mean age of 32.64 years. Over 50% of odontogenic tumors were found in the second and third decades of life.

The single most frequent site of involvement for odontogenic tumors was the mandible with 362 cases (74.03%). In the maxilla, only 90 cases were identified that showed the anterior region to be most frequently involved in 63.33% (57 cases).

The overall gender distribution of odontogenic tumors showed a slight male predilection with 51.94% (254/489 cases) in males and 48.06% (235/489 cases) in females.

CONCLUSION:

The present series on the Dravidian population not only reflect differences but also shares similarities among the varied population samples assessed both within India and across the world. The incidence of 4.13% of odontogenic tumors, observed in this study, is the first report from this part of the world involving a largest series from the only Government institution under the Ministry of Health & Family Welfare, Government of Tamil Nadu, India. However, the prevalence of odontogenic tumors reported by this study should not be interpreted in the context of the whole population (predominantly Tamil linguistic people of Dravidian origin) as the hospital based study involves only those populations (Tamil linguistic people of Dravidian origin) that had attended the hospital setting. Further, the population of any given groups do not remain static over the decades studied.

BIBLIOGRAPHY

1). Philipsen HP, Reichart PA. Revision of the 1992-edition of the WHO histological typing of odontogenic tumors. A suggestion. J Oral Pathol Med 2002;31:253-8.

2). Odukoya O. Odontogenic tumors: analysis of 289 Nigerian cases. J Oral Pathol Med 1995;24: 454-7.

3). Ladeinde AL, Ajayi OF, Ogunlewe MO, Adeyemo WL, Arotiba GT, Bamgbose BO, Akinwande JAet al. Odontogenic tumors: aA review of 319 cases in a Nigerian teaching hospital. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2005;99:191-5.

4). Adebayo ET, Ajike SO, Adekeye EO. A review of 318 odontogenic tumors in Kaduna, Nigeria. J Oral Maxillofac Surg 2005;63:811-819.

5). http.//www.chennaicorporation.com/aboutcoc/abouthtm.

6). Günhan O, Erseven G, Ruacan S, Celasun B, Aydintug Y, Ergun E, Demiriz Met al. Odontogenic tumours. A series of 409 cases. Aust Dent J 1990;35:518-22.

7). Chidzonga MM, Lopez VM, Alverez AP. Odontogenic tumors: analysis of 148 cases in Zimbabwe. Cent Afr J Med 1996;42:158-61.

8). Arotiba JT, Ogunbiyi JO, Obiechina AE. Odontogenic tumors: a 15 year review from Ibadan, Nigeria. Br J Oral Maxillofac Surg 1997;35:363-7.

9). Mosqueda- Mosqueda-Taylor A, Ledesma-Montes C, Caballero-Sandoval S, Portilla-Robertson J, Ruíz-Godoy Rivera LM, Meneses-García A.Taylor A, Ledesma- Montes C, Caballero-Sandoval S, Portilla Robertson J, Godoy- Rivera L, Menenses- Garcia A . Odontogenic tumors in Mexico: aA collaborative retrospective study of 349 cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;84:672-5.

10). Lu Y, Xuan M, Takata T, Wang C, He Z, Zhoy Z, et al. Odontogenic tumors. A demographic study of 759 cases in a Chinese population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;

86:-707-14.

11). Santos JN, Pinto LP, dDe_ -Figueredo CR, dDe_Souza LB. Odontogenic tumors: analysis of 127 cases. Pesqui Odontol Bras 2001;;- 15:-308-13.

12). Ochsenius G, Ortega A, Godoy L, Penaflel C, Escobar E. Odontogenic tumors in Chile: a study of 362 cases. J Oral Pathol Med 2002;-31:-415-20.

13). Simon EN, Stoelinga PJ, Vuhahula E, Ngassapa D. Odontogenic tumors and tumor-like lesions in Tanzania. East Afr Med J 2002;-79 (1):-3-7.

14). Adebiyi KE, Odukoya O, Taiwo EO. Ectodermal odontogenic tumours: analysis of 197 Nigerian cases. Int J Oral Maxillofac Surg 2004-;-33 (8):766-70.

15). Tamme T, Soots M, Kulla A, Karu K, Hanstein SM, Sokk A, Jõeste E, Leibur Eet al. Odontogenic tumours, a collaborative retrospective study of 75 cases covering more than 25 years from Estonia. J Craniomaxillofac Surg 2004-;-32 (3):161-5.

16). -Simon EN, Merkx MA, Vuhahula E, Ngassapa D, Stoelinga PJ. A 4-year prospective study on epidemiology and clinicopathological presentation of odontogenic tumors in Tanzania. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2005;-99:598-602.

17). Fernandes AM, Duarte EC, Pimenta FJ, Souza LN, Santos VR, Mesquita RA, DEet al Aguiar MCF. Odontogenic tumors: a study of 340 cases in a Brazilian population. J Oral Pathol Med 2005;-34: 583-7.

18). Buchner A, Merrell PW, Carpenter WM. Relative frequency of central odontogenic tumors: a A sStudy of 1088 cCases from Northern California and comparison to studies from other parts of the world. J Oral Maxillofac Surg 2006;-64:-1343-52.

19). Jing W, Xuan M, Lin Y, Wu L, Liu L, Zheng X, et al. Odontogenic tumors: a retrospective study of 1642 cases in a Chinese population. Int J Oral Maxillofac Surg 2007;-36:-20-5.

20). Olgac V, Koseoglu BG, Aksakalli N. Odontogenic tumors in Istanbul: 527 cases. Br J Oral Maxillofac Surg 2006;-44:-386-8.

21). Okada H, Yamamoto H, Tilakratne WM. Odontogenic tumors in Sri Lanka: analysis of 226 cases. J Oral Maxillofac Surg 2007; 65: 875-82.

22). Sriram G, Shetty RP. Odontogenic tumors: a study of 250 cases in an Indian teaching hospital. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008; 105: e14-e21.

23). Wu PC, Chan KW. A survey of tumors of the jawbones in Hong Kong Chinese: 1963-1982. Br J Oral Maxillofac Surg 1985; 23: 92-102.

24). Adebayo ET, Ajike SO, Adekeye EO. Odontogenic tumors in children and adolescents: a study of 78 Nigerian cases. J Craniomaxillofac Surg 2002; 30: 267-72.

25). Guerrisi M, Piloni MJ, Keszler A. Odontogenic tumors in children and adolescents. A 15-year retrospective study in Argentina. Med Oral Pathol Oral Cir Bucal 2007; 12: E 180-5.

26). Ogunsalu CO. Odontogenic tumors from two centres in Jamaica. A 15-year review. West Indian Med J 2003; 52: 285-9.

27). Culling CFA, editor. Handbook of Histopathologic techniques. London: Butterworths; 1963. p. 199-208.

28). Kramer IRH, Pindborg J.J., Shear M. The WHO Histological Typing of Odontogenic Tumours. A Commentary on the Second Edition. Cancer 1992; 70: 2988-94.

29). www.dciindia.org.

30). Ide F, Obara K, Mishima K, Saito I, Horie N, Shimoyama T, Kusama K et al. Peripheral odontogenic tumor: a clinicopathologic study of 30 cases. General features and hamartomatous lesions. J Oral Pathol Med 2005; 34: 552-7.

31). Philipsen HP, Reichart PA. Classification of odontogenic tumors. A historical review. J Oral Pathol Med 2006; 35: 525-9.

32). Barnes L, Eveson JW, Reichart PA, Sidransky D, editors. et al: World Health Organisation Classification of Tumors. Pathology and Genetics of Head and Neck Tumors Tumors of the Head and Neck. Lyon, France, International Agency for Research on Cancer; 2005.

33). Cawson RA, Binnie WH, Speight PM, Barrett AW, Wright JM, editors. Lucas's pPathology of tTumors of the oOral tTissues. London: Churchill Livingstone;; 1999. p. :25--86.

34). Li TJ, Wu YT, Yu SF, Yu GYet al. Unicystic ameloblastoma: aA cClinicopathologic sStudy of 33 Chinese pPatients. Am J Surg Pathol 2000;24:1385-92.

35). Gardner DG. Plexiform uUnicystic aAmeloblastoma: aA dDiagnostic pProblem in dDentiogerous cCysts. Cancer 1981;47:1358-63.

36). Philipsen HP, Reichart PA. Unicystic ameloblastoma. A review of 193 cases from the literature. Oral Oncol 1998;34:317-25.

37). —Sapp JP, Eversole LR, Wysocki GP, editors. Contemporary oOral and mMaxillofacial pPathology. Missouri : Mosby;; 2004. p. :134--163.

38). Rosenstein T, Pogrel MA, Smith RA, et al Regezi JA. Cystic ameloblastomaameloblastoma-bbehaviour and ttreatment of 21 cases. J Oral Maxillofac Surg 2001;59:1312-16.

39). Swasdison S, Dhanuthai K, Jainkittivong A, Philipsen HP, Dr Odont, Alta G. Adenomatoid odontogenic tumors: an analysis of 67 cases in a Thai population. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2008;105:210-5.

40). Philipsen HP, Reichart PA. Adenomatoid odontogenic tumor mimicking a periapical (radicular cyst): aA case report. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;94:246-8.

41). Philipsen HP, Reichart PA, Siar CH, Ng KH, Lau SH, Zhang X, et al. An updated clinical and epidemiological profile of the adenomatoid odontogenic tumor: a collaborative retrospective study. J Oral Pathol Med 2007;36:383-93.

42). Ulmansky M, Lustmann J, Balkin N. Tumors and tumor-like lesions of the oral cavity and related structures in Israeli children. Int J Oral Maxillofac Surg 1999;28:2911-4.

43). Regezi JA, Scuibba J, editors. Oral pPathology. Clinical-pathologic correlations. Philadelphia: WB Saunders Company;; 1999. p. :323-50.

44). Noffke CEE, Raubenheimer EJ, Chabikuli NJ, Bouckaert MMR. Odontogenic myxoma: review of

the literature and report of 30 cases from South Africa. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;-104:101-9.

45). Neville BW, Damm D, Allen CM, Bouquot JE, editors. Oral and mMaxillofacial pPathology. Philadelphia: Elsevier;- 2005. ;- p. 589-642.

46). Pippi R. Benign odontogenic tumours: cClinical, epidemiological and therapeutic aspects of a sixteen years sample. Minerva Stomatol 2006Stomatol 2006;-55:-503-13.

47). Al-Khateeb T, Al-Hadi Hamasha A, Almasri NM. Oral and maxillofacial tumours in North Jordanian children and adolescents: a retrospective analysis over 10 years. Int J Oral Maxillofac Surg 2003;-32:-78-83.

48). Sato M, Tanaka N, Sato T, Amagasa T. Oral and maxillofacial tumors in children: a review. Br J Oral Maxillofac Surg 1997;-35:-92-5.

49). Buchner A, Merrell WP, Carpenter WM. Relative frequency of peripheral odontogenic tumors: a study of 45 new cases and comparison with studies from the literature. J Oral Pathol Med 2006;-35: 385-91.

50). Reichart PA, Philipsen HP, Sonner S. Ameloblastoma: bBiological pProfile of 3677 cases. Eur J Cancer B Oral Oncol 1995;-31B:-86-99.

51). Chattopadhyay A. Adenomatoid odontogenic tumor. Review of literature and report of 30 cases from India. Indian J Dent Res 1994;-5:-89-95.